NASA SP-7022 (03)
Volume 3 of 4

SPACE COMMUNICATIONS THEORY AND APPLICATIONS

A BIBLIOGRAPHY

Volume 3: Information Processing and Advanced Techniques

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA SP-7022(03)
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SPACE COMMUNICATIONS: THEORY AND APPLICATIONS

A BIBLIOGRAPHY
Volume 3: Information Processing and Advanced Techniques

An extensive collection of annotated references to reports, journal articles, and books published during the period 1958–1963.

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Scientific and Technical Information Division **July 1965**
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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INTRODUCTION

Space Communications: Theory and Applications is a four-volume bibliography compiled by the Federal Systems Division, IBM under contract to the National Aeronautics and Space Administration. It contains an extensive listing of references to reports, articles, and books on several subjects directly pertinent to the field of space communications. The compilers have endeavored to provide maximum coverage of the literature for the period 1958 through 1963. However, references to publications of unusual significance that appeared before 1958, as well as a limited number of 1964 references, have also been included. The bibliography has been prepared primarily for use by communications specialists engaged in technical activities related to the aerospace program. Each of the four volumes is complete in its coverage of specific subjects and is being published separately.

Volumes 1, 2, and 3 are devoted primarily to a theoretical consideration of their subject matter but, when appropriate, references pertaining to applications are also included. Volume 4 contains references to four important and timely applications of space communications. The NASA Special Publication numbers and the particular subjects of each volume are as follows:

NASA SP-7022(01)	Volume 1	Modulation and Channels
NASA SP-7022(02)	Volume 2	Coding and Detection Theory
NASA SP-7022(03)	Volume 3A	Information Processing
	3B	Advanced Techniques
NASA SP-7022(04)	Volume 4A	Communications Satellites
	4B	Instrumented Satellites
	4C	Deep Space Applications
	4D	Manned Space Flight Applications

Each volume contains a Table of Contents for that particular volume and a separate Table of Contents for the complete set of four. For additional reference aid, a subject index is included in each volume. A listing of abbreviations (established by Science Abstracts, Section B, Electrical Engineering Abstracts, London) of widely used journals and periodicals is included in each volume, for the purpose of identifying source documents.

Arrangement of references in the bibliographic listing is based on subjects in accordance with the Table of Contents. Under each specific topic, references are divided into "Principal Publications" and "Related Publications." Within each of these categories, references are listed in chronological order and, when further separation is necessary, by individual author. Each citation to a reference is accompanied by an annotation if the title of the reference is not sufficiently informative. Whenever possible, annotations included in this bibliography have been extracted from the original reference or from its abstract.

For additional information concerning the structure and function of the Table of Contents, and for a detailed description of the arrangement of references, the user is referred to the "User's Guide" which follows this Introduction.

AVAILABILITY OF DOCUMENTS

Articles cited in this bibliography are available for examination in the designated issues of the original journals. Copies of particular issues may be borrowed from libraries maintaining sets of these journals. In some instances, reprints may be obtained by writing to the editorial office of the journal. Copies of many of the reports cited herein can be purchased from the Clearinghouse for Federal Scientific and Technical Information (CFSTI), Springfield, Virginia, 22151. In those cases where CFSTI is unable to provide this service, the requester should direct his inquiry to the originating agency.

Copies of NASA SP-7022 (04), the fourth volume of Space Communications: Theory and Applications, can be obtained from the Scientific and Technical Information Division, National Aeronautics and Space Administration (Code ATSS-A), Washington, D. C., 20546, without charge, by NASA offices and contractors, U. S. Government agencies and their contractors, and organizations that are working in direct support of NASA programs.

Other organizations and individuals can purchase copies of NASA SP-7022 (04) from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., 20402.

USER'S GUIDE

The Table of Contents for each volume best illustrates the general structure of the volume and the arrangement of its contents. The main subject is synonymous with the subtitle of the volume and is designated by the number 1, 2, 3 or 4. Each volume or subject (1) is divided into divisions (1.0, 1.1, 1.2, etc.), sections (1.10, 1.11, 1.12, etc.) and finally, into subdivisions (1.110, 1.111, 1.112, etc.).

Arrangement of references and other text under the four categories is as follows:

> Subject 1: A general description of the contents of the entire volume which briefly identifies all important subtopics.
>
> Division 1.1: A more detailed statement of content is usually presented with emphasis on the fundamental aspects of the topics to be considered. Specific references to related sections and subdivisions are included.
>
> Section 1.10: An explanatory note is provided, when appropriate, to describe a single topic covered in detail in the following subdivisions.
>
> Subdivision 1.100: This is the most limiting level of categorization and will normally contain a complete compilation of information on a specific topic. It opens with a statement that identifies the types of references Included and the types that are Not Included. Cross-reference instructions follow and refer only to those related sections or subdivisions that appear in the same volume. Finally, all citations and annotations appear in this category, divided into two groups: Principal Publication and Related Publications. The last digit of the subdivision number has special significance in the listing of pertinent references. For example, if the complete category number is 1.111, the final "1" signifies that references pertaining to the fundamental and theoretical aspects of the subject appear under it. If the last digit is "7" or "8", the references which appear under it will pertain to specific applications related to the topic under discussion. Similarly, testing and simulation references are denoted when the last digit is "9". The user may note that all of the final digits in a category are not used in the bibliography. This apparent omission does not mean that divisions, sections, or subdivisions are missing but that pertinent references have not been identified at this time. However, the unused numbers have been assigned and if relevant references appear in the future, they can be incorporated in a supplementary or revised issue of the bibliography.

The index for each volume is constructed on a two-tier basis, i.e., a major subject or technical expression and those supporting expressions that are directly associated with the major subject. A special effort has been made to retain the original terminology of authors in the index. New terms and translations of foreign terms, as used by individual authors, have been mixed with older and more familiar expressions and are included in the index in proper alphabetical order.

Duplicate entries to the same reference will be found occasionally within a subdivision. The user will note that both entries are included because different sources are identified and the repetition may provide more convenient access to the reference. Documents originally announced by the Defense Documentation Center (DDC, formerly ASTIA) are designated AD, followed by six digits. Documents originally announced in the NASA journal Scientific and Technical Aerospace Reports (STAR) are designated N62 (or N63, N64) followed by five digits. Documents originally announced in International Aerospace Abstracts (IAA), a journal published by the American Institute of Aeronautics and Astronautics (AIAA), are designated A62 (or A63, A64) followed by five digits.

Titles of foreign language citations have been translated into English.

ABBREVIATIONS OF PRIMARY SOURCE DOCUMENTS

AIEE - American Institute of Electrical Engineers
Conf. - Conference
Conv. - Convention
Engng. - Engineering
IEE - Institution of Electrical Engineers
IEEE - Institute of Electrical and Electronic Engineers
Inst. - Institute
Instn. - Institution
Internat. - International
IRE - Institute of Radio Engineers
J. - Journal
Nat. - National
Proc. - Proceedings
Rec. - Record
Symp. - Symposium
Trans. - Transactions

Ann. Radioelect. - Annales de Radioelectricite
Arch. Elekt. Ubertragung - Archiv der Elektrischen Ubertragung
Avtomat. i Telemekh. - Avtomatika i Telemekhanika
Bell Syst. Tech. J. - Bell Systems Technical Journal
Elektron. Rundschau - Elektronische Rundschau
IRE Trans. Comp. Parts - IRE Transactions Component Parts
IRE Trans. Commun. Syst. - IRE Transactions Communications Systems
IRE Trans. Electronic Comp. - IRE Transactions Electronic Components
IRE Trans. Inform. Th. - IRE Transactions Information Theory
IRE Trans. Microwave Th. Tech. - IRE Transactions Microwave Theory and Techniques
IBM J. Res. Developm. - IBM Journal of Research and Development
J. Appl. Phys. - Journal of Applied Physics
JPL Res. Summ. - JPL Research Summary
JPL Space Progr. Summ. - JPL Space Program Summary
Nachrichtentech. Z. - Nachrichtentechnische Zeitschrift
Proc. Electronic Comp. Conf. - Proceedings Electronic Computer Conference
Radio Engng. - Radio Engineering
RCA Rev. - RCA Review
Rec. Nat. Commun. Symp. - Record National Communications Symposium
Rev. Sci. Instrum. - Review of Scientific Instruments
Telecomm. Radio Engng. - Telecommunications and Radio Engineering

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VOLUME 3

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VOLUME 3 - PART A

INFORMATION PROCESSING

Volume one of this series indicated that some novel modulation methods are emerging which are likely to permit the operation of communications links with extremely weak signals. Indeed, the first impressive results of deep space probes are due to newly developed communications and ranging systems which have the ability to operate with signals virtually buried in noise when picked up by the most sensitive antenna and receiving systems. Complex analog and digital signal processing systems have been developed to extract these extremely weak signals from the simultaneously received noise and disturbances.

Volume two of this series gave references to a number of coding methods which have been investigated theoretically and which are gradually finding applications in space communications. They promise to improve the efficiency of space communications links by orders of magnitude through the application of two principles: Information compaction and information protection. The first principle implies that only essential information is submitted for transmission over the space link. The second principle implies that this compacted information is then protected against loss or damage by check signals, duplicate transmissions and safe arrival acknowledgement procedures. The last section of volume two gave an indication of the many methods which are simultaneously emerging to handle any such compacted and protected information most efficiently under any changing transmission conditions.

Practically all such highly efficient modulation and coding methods require complex processing methods, to handle the analog or digital input data and to transfer them to suitable transmission signals. On the receiving side it is necessary to process the weak signals, which are heavily contaminated by noise, in a similar way to safely recover the original information. This volume, 3A, contains references to the special analog and digital data processing techniques which are available for performing these data and signal handling operations in space communications.

Naturally, the compilers have drawn heavily on the large stock of computer literature in assembling those references which are, or might be in the near future, of particular importance to space communications. Every effort has been made to perform this selection process on a broad but critical basis. It is unavoidable that any such selection will be a subjective one. But the compilers tried to comply with the following ground rules:

1. References to theoretical contributions on specialized processing methods for modulation or coding which are incorporated in volume one or two are not repeated in this volume. This applies for example in the area of pattern recognition (2.26).

2. References to detailed hardware problems are excluded. There are some references to surveys of new logical devices and of novel technologies, such as cryogenics, magnetic film techniques, etc.

3. Subsystems of data processing systems, such as memory systems of phase-lock loops are selectively covered, depending on the potential importance of the individual paper to space communications.

4. Books are covered as completely as the reference sources permitted. No special library search has been made for books, nor have publishers been contacted for complete lists.

Volume 3A is organized in nine divisions, going from a general introduction (3A.0), over systems theory and organization (3A.1) and to a selection of engineering problems, primarily on the subsystems level (3A.2). The division 3A.3 deals with the so-called peripheral equipment, which involves input/output devices and mass-storage media (tape recorders). The next three divisions are devoted to large classes of data processing methods and to some specialized equipment working according to these methods. Involved are digital (3A.4), analog and hybrid (3A.5) processing methods and simulation methods (3A.6). The last two divisions contain references to various application areas of data processing equipment for space communications or related branches. Theses areas are separated in processors for ground stations (3A.7) and for space crafts (3A.8).

DIVISION 3A.0
DATA PROCESSING SYSTEMS IN GENERAL

Space communications designers depend in several areas on established electronic computer technology. First, as a user of general purpose computers; second, as beneficiaries of digital and analog techniques, developed during the last two decades by computer manufacturers and which are readily applicable to many space communications design problems; and third, as customers for special purpose computers for integrated subsystems in space crafts and in ground terminals.

This introductory division contains general references for all three areas, but it has a strong bias towards references which fall into the first area.

In the framework of a bibliography on space communications the reader should not expect a complete coverage of the field of computer technology. Accordingly, the compilers concentrated in this general division on references to books and to general reports covering technological progress. Reports on operational computer systems were included to the extent that they are referenced in the source material of this bibliography. No special search for such references was undertaken.

One area of an advanced character has been included in this general division: Automata. A relatively large number of references have been accepted for this area, but at least ten times as many were omitted. This area seems to be of high potential importance for space communications, but it is too early to appreciate in detail its possible impact on various branches of space electronics. Most likely the first practical applications of learning machines will be in compaction techniques, particularly in pattern recognition. Detailed references to these branches are in Volume 2. Some of the techniques applied in learning systems fall into the area of bionics, which is a subject of Volume 3B of this bibliography. Other techniques are related to efforts in adaptive control systems and we refer the reader to division 2.9 in volume two of this bibliography, which contains references to adaptive communications operations. Considering this, at present, still loose interconnection between self organizing systems (automata) and space communications, the compilers selected references primarily to books and larger research investigations which may give the reader a comprehensive outlook on this new field of a "philosophical technology".

Section 3A.00
Progress of Computer Technology

3A.000: General References to Electronic Computers

Included: Future computers; Trends in computer engineering; Data processing systems advances; High efficiency computing systems; Historical references on computer evolution.

Cross References: Theory and organization of computer systems (Div. 3A.1); Handbooks in computer technology (3A.001); Computer development in various countries (3A.001); Descriptions of operational computers designed in the U. S. A. (3A.020); Operational computers designed outside the U. S. A. (3A.080); Books on digital computers (3A.003); Books on analog computers (3A.002).

Principal Publications:

REVIEW OF COMPUTER PROGRESS IN 1957
R. P. Castanias, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 65/72.

HIGH SPEED COMPUTING
S. H. Hollingdale, New York, The Macmillan Co., 1959, 266 p.

COMPUTERS OF THE FUTURE
R. Rice, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 8/14.

1958 PGEC MEMBERSHIP SURVEY REPORT
K. W. Uncapher, IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 60/67.

ANALOGUE AND DIGITAL COMPUTERS
A. C. Haley and W. E. Scott, (editors), New York, The Philosophical Library, Inc., 1960, 308 p.

ELECTRONIC COMPUTERS, PRINCIPLES AND APPLICATIONS (second edition,)
T. E. Ivall, London, England, Iliffe & Sons Ltd., 1960, 259 p.

COMPUTER ENGINEERING (Translated From Russian)
S. A. Lebedev (editor), New York, Pergamon Press, 1960, 184 p.

. . . a collection of eight papers . . . the topics and the treatments are such as to provide very little new information . . .

ADVANCES IN COMPUTERS (VOL. 3)
F. L. Alt and M. Rubinoff (editors), New York, Academic Press, Inc., 1962, 347 p.

TRENDS IN COMPUTER ENGINEERING
W. S. Elliott, Proc. Instn. Elec. Engrs. London, Pt. B., vol. 109, no. 43, Jan. 1962, p. 15/21, 22 refs.

MANAGEMENT AND THE COMPUTER OF THE FUTURE
M. Greenberger (editor), New York, John Wiley and Sons, Inc., 1962, 324 p.

THE NEXT GENERATION OF COMPUTERS
Control Engng., vol. 9, Feb. 1962, p. 22/25.

. . . New types of machine organization . . . One type of computer already in use employs two information channels instead of an arithmetic unit. . . .

TELEPHONE SWITCHING AND THE EARLY BELL LABORATORIES COMPUTERS
E. G. Andrews, Bell Syst. Tech. J., vol. 42, no. 2, March 1963, p. 341/353.

This article summarizes the salient features of seven relay-type computers designed and built at Bell Telephone Laboratories. . . .

DATA PROCESSING SYSTEM ADVANCES
R. R. Johnson, Electronics Industries, vol. 22, June 1963, p. K3/K6, K13, A63-20759.

COMPUTERS, AUTOMATION, AND PROCESS CONTROL
T. J. Williams, I & EC - Industrial and Engineering Chemistry, vol. 55, Nov. 1963, p. 43/45, A64-11660.

Brief review of 107 papers published between April 1, 1962 and March 31, 1963 . . . computers in general, process control (dynamics and components), process control theory, systems engineering, and automation.

HIGH EFFICIENCY COMPUTING SYSTEMS
E. Z. Yevreinov, et al., In its News of the Acad. of Sci. USSR, Dept. of Tech. Sci. Tech. Cybernetics, no. 4, 1963, 11 Dec. 1963, p. 1/35, refs., N64-12452.

MILDATA STUDY. A STUDY OF ADVANCED TECHNIQUES IN ALL ASPECTS OF DATA PROCESSING APPLICABLE TO CCIS IN THE TIME FRAME 1975-1985
Minneapolis-Honeywell Electronic Data Processing, Wellesley Hills, Mass., Quarterly progress rept. no. 1, 12 Aug.-8 Nov. 1963, Rept. no. SCL4529, 8 Nov. 1963, lv., AD 428 631.

TRANSACTIONS OF THE ALL UNION CONFERENCE ON COMPUTER MATHEMATICS AND COMPUTER APPLICATION 3-8 FEBRUARY 1958 (SELECTED ARTICLES)
Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 23 April 1963, 62 p., AD 415 675.

Related Publications:

GAMES THAT TEACH THE FUNDAMENTALS OF COMPUTER OPERATION
D. C. Engelbart, IRE Trans. Electronic Comp. vol. EC-10, no. 1, March 1961, p. 31/41.

RESEARCH ON CORRUPTED DATA PROCESSING SYSTEMS
A. R. Bergen, et al., California U., Berkeley, Electronics Research Lab., Sci. Rept. 11; IER Ser. 60, Issue 472; AFCRL-62-780, Final Rept, June 1, 1959-May 31, 1962, 1 June 1962, 15 p., 26 refs., N63-17505.

. . . includes research on randomly time-varying systems, optimal control systems, and the stability of nonlinear control systems.

A UNIFIED APPROACH TO DATA PROCESSING
F. Godwin (British Interplanetary Society, Symposium on Ground Support Facilities in Astronautics, March 6, 1963, London, England, Paper), British Interplanetary Society, Journal, vol. 19, Sept.-Oct. 1963, p. 212/223, A64-10075

. . . data processing requirements for space vehicles, under the categories of guidance and control, telemetry-data reduction, and measurement of important constants, such as the astronomical unit and the gravitational parameters of celestial bodies. . . .

FIRST CONGRESS ON THE INFORMATION SYSTEM SCIENCES. SESSION 17. THE FLEXIBILITY OF AUTOMATED INFORMATION SYSTEMS
Mitre Corp., Bedford, Mass., Rept. no. SS17, ESD TDR63 474 17, Oct. 1963, 31 p., AD 422 457.
The common characteristics of all types of information systems are detailed, with systems defined as having procedural restrictions and orderliness. . . .

3A.001: Computer Technology Reviews

Included: Handbooks; Reports on developments in various countries; Terminology in computer engineering; Bibliographies on computers; Comparisons between various computers; Tables of computer characteristics; Quantitative methods of computer system evaluation.

Cross References: General trends in computer engineering (3A.000); Specifications of individual computers (3A.020 and 3A.080); Trends in computer systems research and analysis (3A.100).

Principal Publications:

HANDBOOK OF AUTOMATION, COMPUTATION, AND CONTROL. VOLUME 2 - COMPUTERS AND DATA PROCESSING
E. M. Grabbe, et al., New York, John Wiley & Sons, Inc., 1959, 1033 p.

RUSSIAN VISIT TO U.S. COMPUTERS
E. M. Grabbe, S. Ramo, D. E. Wooldridge, New York, John Wiley & Sons, Inc., 1959, 1033 p.

In April and May, 1959 an exchange of visits by computer experts took place. . .

The visit of the U. S. delegation to Russia will be reported separately in a joint article edited by Willis Ware that will appear in the March, 1960 issue of these transactions.

SOVIET COMPUTER TECHNOLOGY—1959
W. H. Ware (editor), IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 72/120.

. . . descriptions of specific Soviet computers, descriptions of certain computing centers, a discussion of Soviet computer-oriented education, and a description of current circuit and component development.

A DICTIONARY OF SWITCHING THEORY TERMS
Ad Hoc Group, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 630.

Summary only.
To facilitate the spread of knowledge in the field of switching theory, an ad hoc group of the AIEE Computing Devices Committee is preparing a dictionary of relevant terms.
The present reports consists of a list of terms, some with definitions and some without, which is intended to illustrate the nature of the proposed work. . . .

A COMPARISON OF COMPUTERS
F. G. Curl, Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 542/547.

A routing simulating the operation of an analog computer was constructed for use on a digital computer at the Jet Propulsion Laboratory. This code, called DEPI, as an abbreviation for "differential equations pseudo-code interpreter," provides much of the flexibility and ease of operation associated with analog computer operation. A study was made in which the speed, accuracy, and flexibility of the DEPI system were compared with those attributes in a digital differential analyzer, an analog computer, and a digital computer. . . .

SOVIET CYBERNETICS AND COMPUTER SCIENCES—1960
E. A. Feigenbaum, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 759/776.

HANDBOOK OF AUTOMATION COMPUTATION AND CONTROL, (Volume 3)
E. M. Grabbe, S. Ramo, D. E. Wooldridge (editors), New York, John Wiley & Sons, Inc., 1961, 1158 p.

The third in a three volumed series . . . major objective is to provide practical design data for research, development and design in feedback control, computers, data processing, control components and control systems. . . .

POCKET DICTIONARY OF COMPUTER TERMS
H. W. Sams Technical Staff (comp.), Indianapolis, Indiana, Howard W. Sams and Co. Inc., 1962, 96 p.

TASCHENBUCH DER NACHRICHTENVERARBEITUNG (Handbook of Information Processing) (In German)
K. Steinbuch, Berlin, Springer-Verlag, 1962, 1521 p.

COMPUTER HANDBOOK
New York, McGraw-Hill Book Co., Inc., 1962, 1272 p., A63-21741.

Comprehensive presentation of the general principles of design and utilization of analog and digital computers. Components are discussed in detail; actual circuit diagrams are included as examples of design principles, or for adaptation to the designer's problem. . . .

RESEARCH AND EDUCATIONAL ACTIVITIES IN MACHINE COMPUTATION BY THE COOPERATING COLLEGES OF NEW ENGLAND
Computation Center, Mass. Inst. of Tech., Cambridge. Progress rept. no. 10, Jan. 1962, 150 p., AD 414 772.

FOREIGN DEVELOPMENTS IN MACHINE TRANSLATION AND INFORMATION PROCESSING NO. 109
Joint Publications Research Service, Washington, D. C., JPRS: 15839, 22 Oct. 1962, 27 p., AD 299 150.

Contents: Mechanization of sorting large volumes of information, by A. F. Smirnov. Determination of letter combinations through statistical analysis of test matter by K. I. Kurbakov and R. V. Smirnov.

QUANTITATIVE METHODS OF INFORMATION PROCESSING SYSTEM EVALUATION
P. W. Abrahams, et al., ITT Data and Information Systems Div., Paramus, N. J., ESD TDR 63 670, Rept. no. 5201TR0072, Oct. 1963, 105 p., AD 433 220.

. . . to develop practical methods for specifying the characteristics of a data processing system and for comparing the performance of different systems. The methods cover both functional characteristics and engineering characteristics. . . .

THE EUROPEAN COMPUTER SCENE: 1963.
A. S. Douglas, Datamation, vol. 9, Aug. 1963, p. 24/26, A63-21827.

. . . Among the computers noted in the British Atlas, which has internal computing speeds three times higher than those of the IBM 7090. . . .

RUSSIAN COMPUTERS
J. P. Eckert, Industrial Research, vol. 5, July-Aug. 1963, p. 48/55, A63-20399.

. . . The Soviet M-20 is generally considered their best mass-produced unit; there are about 50 in use . . . their speed . . . apparently handling 20,000 operations/sec, with a memory capacity of 4,096 words. . . .

QUANTITATIVE METHODS FOR INFORMATION PROCESSING SYSTEMS EVALUATION
A. Taylor, et al., Auerbach Corp., Philadelphia, Pa., Final rept., March 1963-Jan. 1964. Jan. 1964, 278 p., AD 435 557.

The Vector Process is a new procedure for producing quantitative, objective estimates of the performance of digital computer systems. . . . production of descriptions, in standardized formats, of the characteristics of each problem to be solved and each computer system to be considered. . . .

A BIBLIOGRAPHY OF FOREIGN DEVELOPMENTS IN MACHINE TRANSLATION AND INFORMATION PROCESSING
J. L. Walkowicz, National Bureau of Standards, Washington, D. C., NBS TN 193, 10 July 1963, 191 p., AD 411 483.

A FOURTH SURVEY OF DOMESTIC ELECTRONIC DIGITAL COMPUTING SYSTEMS
M. H. Weik, Jr., Aberdeen Proving Ground, Md. Ballistic Research Labs., BRL-1227; Supplements BRL-1115, PB-171265, Jan. 1964, 378 p., refs., AD 429 000, N64-14718.

. . . the engineering and programing characteristics of 112 different electronic digital computing systems that have been developed since 1961. . . Fifteen comparative tables are included. . .

FIRST CONGRESS ON THE INFORMATION SYSTEM SCIENCES SESSION. 15. INFORMATION SYSTEM PERFORMANCE EVALUATION
Mitre Corp., Bedford, Mass., Rept. no. SS15, ESD TDR 63 474 15, Jan. 1964, 59 p., AD 428 839.

Descriptors . . . Information retrieval . . . Decision making, Simulation. . . problems of evaluating the performance of a military information processing system between the time it is devised and the time when it is obsoleted. . . .use of the ADCS Training Program. . . application of Normative Exercising as a system design aid. . . .

SOVIET RESEARCH IN DATA PROCESSING
Joint Publications Research Service, Washington, D. C., Aug. 15, 1963, 267 p., 95 refs., Transl. into English of 13 articles from various Russian-language Physico-Mathematical Publications 1961-1962, JPRS-20660; OTS-63-31540, N63-21085.

3A.002: Analog Computers in General

Included: Development reports on analog computer technology; Optical analog computers; Packaged analog computers.

Not Included: Analog modulation systems (1).

Cross References: Analog computation methods (Div. 3A.5); Hybrid analog-digital computing systems in general (3A.004); Hybrid computation methods (Div. 3A.5); Digital programming of analog computers (3A.150).

Principal Publications:

OPTICAL ANALOG COMPUTERS
B. J. Howell, J. Opt. Soc. Amer., vol. 49, Oct. 1959, p. 1012/1021.

Certain applications of optical devices in digital computers are described and a general theory of optical analog computers is developed.

THE PACKAGED ANALOGUE COMPUTER
J. C. Cockram, Proc. Instn. Radio Engrs. Australia, vol. 21, no. 12, Dec. 1960, p. 886/889.

A short description is given of a general purpose analogue computer composed of up to eighteen computing units. A detachable patch cord panel and rapidly set coefficient potentiometers reduce the setting up time for a problem. . . .

ANALOG COMPUTATION
A. S. Jackson, New York, McGraw-Hill Book Co., Inc., 1960, 652 p.

. . . thorough discussion of a number of classes of mathematical problems which can be solved by means of analog computers.

ANALOGUE COMPUTERS
I. T. Eterman, Oxford, England, Pergamon Press, Ltd., 264 p.

. . . produced from the original Russian by the combined efforts of a translator, G. Segal, and a technical editor. . .

ANALOGUE COMPUTATION
S. Fifer, New York, McGraw-Hill Book Co., Inc., 1961, 1293 p., 4 vols.

ANALOGUE COMPUTATION TECHNIQUES AND COMPONENTS
R. W. Williams, New York, Academic Press, Inc., 1961, 271 p.

. . . used in aircraft flight simulators. . . . emphasis is upon components, their design and accuracy. Also, more than the usual attention is given to ac amplifiers and resolvers as opposed to their dc counterparts. . . .

AN INTRODUCTION TO ELECTRONIC ANALOGUE COMPUTERS
M. Hartley, London, England, Methuen and Co., Ltd., 1962, 155 p.

APPLICATIONS OF AN ANALOGUE COMPUTER TO INDUSTRIAL PROBLEMS
A. F. Smith, Proc. Instn. Radio Engrs. Australia, vol. 23, no. 11, Nov. 1962, p. 653/658.

PROPOSED IRE STANDARDS FOR ANALOG COMPUTERS
IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 67/79.

Related Publications:

AN ANALOG INPUT AND OUTPUT SYSTEM FOR A REAL-TIME PROCESS CONTROL COMPUTER SYSTEM
C. A. Walton, Proc. Joint Automatic Control Conf. (section 13), 1962, no. 7-12.

. . . a brief technical report on the input and output features of the IBM 1710 Process Control System. . . . Intended as an input/output system for the IBM 1620 computer. . .

THE USE OF ANALOGUE COMPUTERS IN SOLVING PROBLEMS OF FLIGHT MECHANICS
F. C. Haus, et al., Advisory Group for Aeronautical Research and Development, Paris, France, June 1960, 564 p., 30 refs., AGARDograph-44, N63-17770.

AN ANALOG COMPUTER FOR THE SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS
R. C. Propst, et al., DuPont De Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab., Dec. 1963, 22 p., refs., N64-15928.

A desk-top computer was designed to solve up to nine simultaneous linear equations rapidly by means of an iterative technique and an oscilloscopic display system. . .

AUTOMATIC DIGITAL PROGRAMMING OF ANALOG COMPUTERS
M. L. Stein, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 100/111.

A digital technique for manipulating symbols defining a mathematical expression is introduced and it is shown how this technique can be applied so that a digital computer can automatically compile an analog computer program directly from a mathematical description of the problem to be solved.

3A.003: Digital Computers in General

Included: Digital computer principles; General purpose digital computing systems; Digital information processors.

Not Included: Digital modulation methods (1).

Cross References: Special digital data processing methods (Div. 3A.4); Theory of digital computer operation (Sect. 3A.11).

Principal Publications:

MATHEMATICS AND COMPUTERS
G. R. Stibitz, J. A. Larrivee, New York, McGraw-Hill Book Co., Inc., 1957, 234 p.

The eleven chapters of this book cover nearly all phases of digital computer design and use.

BASICS OF DIGITAL COMPUTERS
J. S. Murphy, New York, John F. Rider Publisher. Inc., 1958, 372 p.

ELEKTRONNYE TSIFROVYE MASKINY I PROGRAMMIROVANIE (Electronic Digital Computers and Programming) (In Russian)
A. I. Kitov, A. N. Krinitskii, Moscow, Fizmatgiz, 1959, 572 p.

. . . A detailed account is given of the modern method of programming for the batch-produced Soviet machine "strela". . . .

DIGITAL COMPUTER FUNDAMENTALS
T. C. Bartee, New York, McGraw-Hill Book Co., Inc., 1960, 342 p.

. . . intended to serve as a text for self-study or for an introductory undergraduate course having as prerequisites a first course in electronics and a knowledge of elementary algebra. . . .

THE HISTORICAL DEVELOPMENT AND PREDICTED STATE-OF-THE-ART OF THE GENERAL PURPOSE DIGITAL COMPUTER
C. P. Bourne, et al., Proc. Western Joint Comp. Conf., May 1960, p. 1/21.

This paper presents "scatter" diagrams and graphs for the more usual quoted characteristics of about 300 computers. The charts cover the years from 1944 to somewhat past 1960 and thus cover machines yet expected to be finished. . . .

GENERAL PURPOSE DIGITAL COMPUTING SYSTEMS
A. H. Freilich, Electronic Industr., vol. 19, no. 2, Feb. 1960, p. 70/75.

. . . discussion of the use of general-purpose digital computers in process control applications, nine such computers are described and compared. . . .

DIGITAL COMPUTER PRINCIPLES
W. C. Irwin, Princeton, N. J., D. Van Nostrand Co., Inc., 1960, 314 p.

. . . is a good, self-contained, up-to-date introduction to the engineering principles, involved in present-day general-purpose digital computers. It is written at the level of a mature industrial technician or advanced college undergraduate, and does not prerequisite any specially related technical background.

RESULTS OF SIMULATION COMPARISON OF CONTROL COMPUTERS
G. T. Sendzuk, Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 547/550.

In considering a digital computer for use in a control system, two types of digital computers are generally recognized today: whole word, commonly referred to as general-purpose, and partial word or incremental computers. . . . neither of them can solve all problems. . . . In an attempt to aid in the process of selection for a given application a comparison of digital computers by simulation techniques was made by programming the operation of both incremental and whole-number machines on a general-purpose computer. . . .

UNDERSTANDING DIGITAL COMPUTERS
P. Siegel, New York, John Wiley and Sons, Inc., 1961, 403 p.

ELECTRONIC DIGITAL COMPUTERS
G. D. Smirnov, Oxford, England, Pergamon Press Limited, 1961, 104 p.

. . . Translated from the Russian "Electronic Digital Computers" gives an account of the mathematical fundamentals of construction of such computers. . . .

DIGITALE RECHENANLAGEN (Digital Computers) (In German)
A. P. Speiser, Berlin, Springer-Verlag, 1961, 432 p.

THEORY AND DESIGN OF DIGITAL MACHINES
T. C. Bartee, I. L. Lebow, I. S. Reed, New York, McGraw-Hill Book Co., Inc., 1962, 324 p.

. . . intended to be a text for a senior or first-year graduate level course on digital machine design fundamentals.

DIGITAL COMPUTER DESIGN FUNDAMENTALS
Y. Chu, New York, McGraw-Hill Book Co., Inc., 1962, 371 p.

DIGITAL INFORMATION PROCESSORS
W. Hoffman (editor), New York, John Wiley and Sons, Inc., 1962, 717 p.

. . . tutorial survey of new developments for the specialist. It consists of 16 independent articles on various facets of information processing. . . Approximately 60 per cent of the text is in German; the rest, in English . . .

HARVARD SYMPOSIUM ON DIGITAL COMPUTERS AND THEIR APPLICATIONS, PROCEEDINGS (vol. 31, Cambridge, Mass., April 3-6, 1961)
Cambridge, Mass., Harvard University Press, 1962, 332 p., A63-19354.

Collection of papers which represent a cross section of university research, actual or planned, related to computers, including significant problems of computer design and applications. . . .

DIGITAL COMPUTER ENGINEERING
H. J. Gray, Englewood Cliffs, N. J., Prentice-Hall, Inc., 1963, 368 p.

. . . deals primarily with the circuit designers' contribution to the design of digital computers. It should be of value for home study and as a reference for the practicing circuit designer as well as a classroom text. . . .

Related Publications:

ASPECTS OF REAL-TIME SIMULATION
W. F. Bauer, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 134/136.

. . . An existing large-scale (Univac Scientific 1103A-Epsco converter—Electronic Associates) analog-digital system is described.

. . . Techniques for exploiting each computer's advantages are mentioned. Applications in the guided missile field and in other fields are discussed.

DIGITAL PROCESSES FOR SAMPLED DATA SYSTEMS
A. J. Monroe, New York, John Wiley and Soms, Inc., 1962, 490 p.

. . . to be used as a self teaching aid. . . . concerned with the use of a digital computer as a data processing device, and presents analytical methods for constructing digital programs and digital to analogue converter weighting functions. It also features a composite design criterion that weds transient behavior design and noise-conscious design. . . .

3A.004: Hybrid Computation in General

Included: Analog-digital computers; Hybrid computers.

Not Included: Hybrid modulation methods (1); Pulse code modulation with analog vernier (1).

Cross References: Hybrid data processing methods (Div. 3A.5).

Principal Publications:

ASPECTS OF REAL-TIME SIMULATION
W. F. Bauer, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 134/136.

. . . There is and will continue to be fertile application fields for analog-digital computer combinations. An existing large-scale (Univac Scientific 1103A-Epsco converter—Electronic Associates) analog-digital system is described.

A HIGH-SPEED ANALOG-DIGITAL COMPUTER FOR SIMULATION
R. C. Lee, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 186/196.

. . . capable of simulating complex physical systems in real time. Information in the machine is represented by an analog voltage pulse and a digital number. Arithmetic operations are performed in time-shared analog computing components and conventional digital logical elements. A novel floating-point arithmetic feature is provided to extend the dynamic range of the machine variables.

HYBRID COMPUTERS FOR PROCESS CONTROL
G. Birkel, Jr., Commun. and Electronics, vol. 79, no. 52, Jan. 1961, p. 726/734.

There is a need in industry for equipment of moderate complexity and cost capable of solving simple process control equations at high speed. Quite economical process control and processing of instrumentation data may be accomplished by a hybrid computer. . . .

ANALOG-DIGITAL COMPUTERS FOR REAL-TIME SIMULATION
M. E. Connelly, Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab., Feb. 19, 1962, 121 p., 55 refs., N63-20964.

. . . The design of an analog-digital computer utilizing the pulsed-analog concept is outlined with emphasis on the problems of selecting an efficient order code and a suitable word length and word structure. It is concluded that the use of peripheral pulsed-analog equipment would increase the effective computing speed of a given digital computer on simulation problems by a factor of two or more.

EXPERIENCE WITH HYBRID COMPUTATION
E. M. King, et al., Proc. A FIPS Fall Joint Computer Conf., Philadelphia, Pa., Dec. 1962, p. 36/44.

The paper is written in three sections dealing, respectively, with the relative merits of digital and analogue computation, the advantages claimed for hybrid methods, and some of the hybrid programs with which the authors have had experience.

COMMENTS ON "REAL-TIME ANALOG-DIGITAL COMPUTATION" (Correspondence)
A. L. Vivatson, et al., IRE Trans. Electronics Comp., vol. EC-11, no. 5, Oct. 1962, p. 707/708.

APPLICATION STUDIES OF COMBINED ANALOG-DIGITAL COMPUTATION TECHNIQUES
F. B. Hills, Massachusetts Inst. of Tech., Electronic Systems Lab., Cambridge, ESL-FR-165; AFCRL-63-72, Feb. 1963, 81 p., 53 refs., N63-16395.

Related Publications:

PATTERN DISPLAY CONSIDERATIONS FOR A PROGRAMMING AID MACHINE LINKING A DIGITAL AND AN ANALOGUE COMPUTER
W. Becker, et al., European Atomic Energy Community, Brussels (Belgium), Joint

Nuclear Res. Center, Ispra Establishment (Italy), 1963, 26 p., refs., (EUR-410e) Available from Belgian American Bank and Trust Co., N. Y., account No. 121.86: 40 BF, N64-15717.

A short introduction to the question of auxiliary means linking the output of a digital computer to the patch panel of an analog computer, in order to assist in setting up the connections on the patch panel. . .

3A.008: Special Purpose Computers

Included: Special purpose computers for machine-tool control; Conditional probability computers; "Polynom", a Russian special purpose simulator; Frequency-to-period-to-analog computer.

Not Included: Special purpose control systems; Military computers; Fire control Computers.

Cross References: Special digital data processing methods (Div. 3A.4); Hybrid data processing methods (Div. 3A.5); Simulation methods (Div. 3A.6); Computers in space electronics ground systems (Div. 3A.7); Space-borne computers (Div. 3A.8).

Principal Publications:

DIGITAL INFORMATION PROCESSING FOR MACHINE-TOOL CONTROL
A. K. Sussking, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 136/140.

. . . more sophisticated tasks require the addition of general-purpose large-scale computers. This combination, while only partially explored, appears very promising. . . . should ultimately assist in the design procedure.

FREQUENCY-TO-PERIOD-TO-ANALOG COMPUTER FOR FLOW RATE MEASUREMENT
T. W. Berwin, IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 62/71.

. . . a special purpose nonlinear analog computer which accepts an ac voltage of varying frequency, acts upon the period of each cycle, computes the inverse of the time period, e=1/T, and holds the information for the period of the next cycle. Thus, the output voltage is a level which is proportional to the input frequency f = 1/T computed once for every cycle.

"POLINOM" SPECIAL-PURPOSE ELECTRONIC-RELAY DIGITAL SIMULATOR
G. G. Men'shikov, et al., Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 10, 1961, p. 61/70.

. . . designed for computing the functional series of a wide class of functions encountered in radio engineering practice. The computer was designed and constructed in 1959. . . special-purpose computer. . . in which the programming operation does not employ methods of digital simulation. . . .

THE DEVELOPMENT OF A CONDITIONAL PROBABILITY COMPUTER FOR CONTROL APPLICATIONS
H. C. Ratz, et al., Saskatchewan U., Canada, Electrical Engineering rept. no. 62R13, Nov. 1962, 13 p., incl. illus., 8 refs., AD 297 899.

. . . special purpose computer. . . continuously measures time-weighted frequencies of binary patterns, and from these deduces certain conditional probabilities. . . . been applied to the control task of optimizing a process simulated by an analog electrical network. . . . remains useful in the face of considerable interaction among the control variables.

THE DEVELOPMENT OF A CONDITIONAL PROBABILITY COMPUTER
H. C. Ratz, et al., Saskatchewan U., Canada, Rept. no. 62R14, Oct. 1962, 15 p., AD 298 687.

DESIGN STUDIES OF CONDITIONAL PROBABLIITY COMPUTERS
K. H. Reid, Saskatchewan U., Canada, 1962, 8 p., AD 404 977.

Related Publications:

DATA PROCESSING FOR COMMUNICATION NETWORK MONITORING AND CONTROL
D. I. Caplan, Proc. A. FIPS Fall Joint Comp. Conf., Dec. 1962, p. 147/154.

. . . The central part of the paper is the use of an automatic high-speed information processor backed up by a record file for bulk storage.

Section 3A. 01
Computers and Automation

3A. 010: Automation Trends

Included: Automatic techniques in general Progress in automation.

Not Included: Economical aspects of automation; Sociological aspects of automation; Statistics on automation.

Cross References: Automation of space craft checkout procedures (3A. 790); Automatic diagnostic repair procedures in computers (3A. 170); Simulation of electronic circuit design (3A. 630).

Principal Publications:

AUTOMATIC TECHNIQUES, LARGE COMPUTERS, AND ENGINEERING CALCULATIONS
V. Paschkis, IRE Trans. Indust. Electronics, vol. PGIE-7, Aug. 1958, p. 27/32.

AUTOMATION AND COMPUTING
A. D. Booth, New York, The Macmillan Co., 1959, 155 p.

VYCHISITEL'NYE USTROISTVA V AVTOMATICHESKIKH SISTEMAKH (Computing Devices in Automatic Systems) (In Russian)
A. A. Fel'dbaum, Moscow, Fizmatgiz, 1959, 800 p.

. . . theory of automatic systems. . . . construction of computing devices. . . . introducing computing devices into automatic systems. . . . extensive list of references . . .

AUTOMATION IN BUSINESS AND INDUSTRY
E. M. Grabbe (editor), New York, John Wiley and Sons, Inc., 1959, 611 p.

. . . based on a series of lectures given by a number of prominent engineers and scientists at the University of California. . . .

PROGRESS IN AUTOMATION (VOL. 1)
A. D. Booth (editor) London, Butterworth Scientific Publications, 1960, 231 p.

The first volume of the Series is devoted to eleven papers from leading British experts in the field of mechanical automation. . . .

AUTOMATION IN ORBITAL AND SPACE MISSIONS
W. L. Mitchell, et al., NASA, Marshall Space Flight Center, Huntsville, Ala., In its Peenemunde to Outer Space (A Volume of Papers) Commemorating the Fiftieth Birthday of Wernher Von Braun, March 23, 1962, p. 95/105, N63-15981.

ON THE EXPLOSION OF AUTOMATION
R. Bellman, RAND Corp., Santa Monica, Calif., Rept. no. P2865, Feb. 1964, 5 p., AD 429 897.

Related Publications:

DESIGN AUTOMATION—A LOOK AT THE FUTURE
G. L. Baldwin, et al., Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 510/512.

. . . improvements . . . by means of improved descriptive languages and programming . . . analogies with the general field of automatic coding. The aspects considered are: data definition (symbolic references to items and indexing of repetitive arrays of units); subroutines, subsystems, and macros for describing identical and nearly identical units occurring throughout a system; diagnosis and check-out programs; and the organization of sets of design automation programs. . . .

3A. 016: Automata

Included: Artificial intelligence; Intelligent automata; Principle of self-organization; Cybernetics and automata; Self-learning systems; Finite counting automata; Adaptive learning systems; Push-down automata; Probabilistic automata; Learning automata; Machine learning; Self-organizing machines; Theorem utilizing programs; Logic theory machine; Mechanization of mental activities; Finite-memory binary automata; Autonomous automata; Sequential machines as automata; Probability state variable systems (PSV).

Not Included: Bionics (3B); Physiological research; Pattern recognition methods (2); Adaptive communications techniques (2); Cybernetics and information theory (1); Teaching machines.

Cross References: Character readers (3A. 342); Simulation methods (Div. 3A. 6); Computer programming (Sect. 3A. 15); Theory of switching systems (Sect. 3A. 12); Switching theory of sequential machines (Sect. 3A. 12).

Principal Publications:

THE LOGIC THEORY MACHINE: A COMPLEX INFORMATION PROCESSING SYSTEM
A. Newell, et al., RAND Corp., Santa Monica, Calif., Rept. no. P868, Rev., 12 July 1956, 63 p., AD 422 840.

. . . is capable of discovering proofs for theorems in symbolic logic. This system, in contrast to the systematic algorithms that are ordinarily employed in computation, relies heavily on heuristic methods similar to those that have been observed in human problem solving activity. . . .

EMPIRICAL EXPLORATIONS OF THE LOGIC THEORY MACHINE: A CASE STUDY IN HEURISTICS
A. Newell, et al., RAND Corp., Santa Monica, Calif., Report no. P951, Rev., 14 March 1957, 48 p., AD 422 841.

SYMBOLIC LOGIC AND INTELLIGENT MACHINES
E. C. Berkeley, New York, Reinhold Publishing Corp., 1959, 208 p.

AUTOMATION, CYBERNETICS, AND SOCIETY
F. H. George, New York, Philosophical Library, Inc., 1959, 283 p.

A SELF-ORGANIZING BINARY SYSTEM
R. L. Mattson, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 212/217.

. . . concerned with pattern-recognition processes in which the pattern classes are determined by the so-called "linearly separated" Boolean functions.

LOGICAL MACHINE DESIGN II: A SELECTED BIBLIOGRAPHY
D. B. Netherwood, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 367/380.

FINITE AUTOMATA AND THEIR DECISION PROBLEMS
M. O. Rabin, et al., IBM J. Res. Developm., vol. 3, April 1959, p. 114/125.

. . . consider a number of models of sequential machines which require only a finite number of internal states and a finite, but variable-length, tape for their operation.

ATTITUDES TOWARD INTELLIGENT MACHINES
P. Armer, Bionics Symp., 1960, p. 13/39.

Two worthwhile things are accomplished in this paper, 1) disposing of a lot of foolishness concerning the question "Can machines think?," and 2) comparing the attitudes and progress of the Russians in the area of research on intelligent machines with those in the West.

CHARACTERIZING EXPERIMENTS FOR FINITE-MEMORY BINARY AUTOMATA
A. Gill, IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 469/471.

The characteristics of a discrete automaton with a finite memory can be determined by an experiment of a finite length. This paper discusses the properties of such experiments, and presents methods for their optimal construction. Specific results are given binary-input automata with the memory ranges 0, 1, 2, 3 and 4.

CONNECTIVE PROPERTIES PRESERVED IN MINIMAL STATE MACHINES
S. Ginsburg, J. Assoc. Comp. Mach., vol. 7, Oct. 1960, p. 311/325.

. . . investigates several properties of incompletely specified sequential machines, which are preserved in at least one minimum state machine of the given machine. . . . readers may find the properties of interest in other connections.

ADAPTIVE SWITCHING CIRCUITS
B. Widrow, et al., IRE WESCON Conv. Rec., no. 4, 1960, p. 96/104.

In the present paper, a . . . system is considered, in which each mosaic point connects through its own individual adjustable weight to a single time-invariant threshold-element. This simplified system is more amenable to analysis, and the authors show that the problem of finding suitable weights in this system involves searching for the minimum of a multidimensional parabolic surface. They have investigated one of the methods for carrying out this search, and have been able, under mathematical restrictions which are not too critical, to estimate the average rate of "learning" (approaching the minimum) and an average error measure as a function of "experience."

TOWARD INTELLIGENT MACHINES
J. D. Williams, RAND Corp., Santa Monica, Calif., Rept. no. P2170, 29 Dec. 1960, 13 p., AD 432 330.

SELF-ORGANIZING SYSTEMS: PROCEEDINGS OF AN INTERDISCIPLINARY CONFERENCE
M. C. Yovits, S. Cameron (editors), New York, Pergamon Press, 1960, 331 p.

. . . held in Chicago May 5-6, 1959. . . . 13 technical papers . . .

SUMMER INSTITUTE FOR SYMBOLIC LOGIC SUMMARIES-(Cornell University, 1957) 2nd ed.)
Communications Res. Div. Inst. for Defense Analyses, Princeton, N. J., July, 1960.

This volume has 83 articles, 17 of which are in the fields of switching theory, theory of automata, computer design and computer programming, and will be reviewed here.

SOVIET CYBERNETICS AND COMPUTER SCIENCES—1960
E. A. Feigenbaum, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 759/776.

AUFZAHLBRAKEIT, ENTSCHEIDBARKEIT, BERECHENBARKEIT (Enumerability, Decidability, Computability) (In German)
H. Hermes, Berlin; Springer-Verlag, 1961, 246 p.

. . . a carefully developed and didactically sound introduction to the theory of recursive functions. The basic concept is that of Turing machine. The author starts with an intuitive discussion of the notion "algorithm." He distinguishes between terminating (abbrechende) and nonterminating algorithms. Familiar examples are given for both kinds of algorithms. . . .

BIBLIOGRAPHY ON SWITCHING CIRCUITS AND LOGICAL ALGEBRA
P. A. Holst, IRE Trans. Electronics Comp., vol. EC-10, no. 4, Dec. 1961, p. 638/661.

. . . Covers material published through 1958, contains nearly 700 references to articles, books, seminars, and other bibliographies pertaining to the theory of switching circuits and logical algebra.

ON THE DEFINITION OF A FAMILY OF AUTOMATA
M. P. Schutzenberger, Inform. Control, vol. 4, no. 2/3, Sept. 1961, p. 245/270.

THE SIMULATION OF COGNITIVE PROCESSES: AN ANNOTATED BIBLIOGRAPHY
P. L. Simmons, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 462/483, 498 refs.

Mathematical models, automata and probabilistics. Formal nerve nets. Simulated neurons and organisms. Pattern recognition. Learning systems. Language processing.

AUTOMAT UND MENSCH. UBER MENSCHLICHE UND MASCHINELLE INTELLIGENZ (Automation and Man. On Human and Artificial Intelligence) (In German)
K. Steinbuch, Berlin, Springer-Verlag, 1961, 253 p.

CYBERNETICS, OR CONTROL AND COMMUNICATION IN THE ANIMAL AND THE MACHINE (Second edition)
N. Wiener, Massachusetts, MIT Press and New York, John Wiley and Sons, Inc., 1961, 212 p.

LERNENDE AUTOMATEN. BERICHT UBER DIE FACHTAGUNG DER NTG IM KERLSRUHE AM 13. UND 14. APRIL 1961 (Learning Automata. Report on a Symposium in Karlsruhe, Germany on April 13 and 14, 1961) (In German)
Munchen, R. Oldenbourg Verlag, 1961, 240 p.

AUTONOMOUS AUTOMATA
L. J. Fogel, Ind. Res., vol. 4, Feb. 1962, p. 14/19.

Self-sufficient machines which can be designed and programmed to pursue the scientific method are discussed. Several approaches toward the design of a self-preserving automaton are outlined including bionics, the replication of the human operator, and that of autonomous automata.

ADAPTIVE LEARNING SYSTEMS
J. E. Gibson, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 795/799.

. . . Two proposed learning systems are described and some results are given to demonstrate the theoretical advantage of a system with learning. . . .

SELF-ORGANIZING SYSTEMS AND THE ABSTRACT THEORY OF COMPUTERS. FOREIGN DEVELOPMENTS IN MACHINE TRANSLATION AND INFORMATION PROCESSING NO. 104.
V. M. Glushkov, Joint Publications Research Service, Washington, D. C., 27 July 1962, 16 p., AD 412 030.

LEARNING PHENOMENA IN NETWORKS OF ADAPTIVE SWITCHING CIRCUITS
M. E. Hoff, Jr., Stanford Electronics Lab., Stanford U., Calif., Technical rept. no. 1554-1; SEL-62-090, ASD TDR 62-767, July 1962, 85 p., incl. illus., tables, 15 refs., AD 288 894.

A practical adaptive (trainable) switching circuit, consisting of an adjustable switching circuit together with a circuit realizing an adjustment procedure, is described. The adjustable switching circuit used has as its output a quantized linear weighted sum of the inputs; the adjustment procedure, known as the minimum-mean-square-error method, consists of iteratively connecting the various input states to the adjustable circuit and making weight changes for each input state based on the circuit's response to that input state. . . .

ENGINEERING CYBERNETICS (Adaptive Automatic Control Systems) (In Russian) (Second edition)
A. G. Ivakhenko, Kiev, Gostekhizdat, UkSSR. 1962, 422 p.

ARTIFICIAL INTELLIGENCE: A SUMMARY OF CURRENT RESEARCH AND DEVELOPMENT
P. A. Lachenbruch, et al., American Inst. for Research, Los Angeles, Calif., Feb. 1962, 178 p., refs., N64-19616.

. . . examining existing physical, mathematical, and logical models of brain functions . . . Relevant literature . . . was reviewed to to update the literature searches previously performed . . . general headings of neurological considerations, special purpose computer models, and general computer program models. A bibliography of 1,129 supplementary specific references and 67 general sources (proceedings of symposia and conferences, anthologies and relevant bibliographies) is presented . . .

THEORY OF PROBABILITY STATE VARIABLE SYSTEMS. VOLUME I. SUMMARY AND CONCLUSIONS
R. J. Lee, et al., Adaptronics, Inc., Alexandria, Va., ASD TDR63 664, vol. 1, Final rept., 15 Oct. 1961 - 14 Oct. 1962, AD 427 872.

A summary is presented of the other five volumes. . . which are mathematical and computer simulation studies of PSV systems . . . Particular emphasis is here placed upon Neurotron artificial nerve cells and networks of these artificial nerve cells which, together with their goal circuits, probably form the most advanced type of PSV systems . . .

REGULAR EXPRESSIONS AND STATE GRAPHS FOR AUTOMATA
R. McNaughton, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1962, p. 39/47.

Algorithms are presented for 1) converting a state graph describing the behavior of an automaton to a regular expression describing the behavior of the same automaton (section 2), and 2) for converting a regular expression into a state graph (sections 3 and 4).

DESIGN PRINCIPLES FOR AN INTELLIGENT MACHINE
M. E. Maron, IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. 179/185.

. . . discusses the role of prediction as the key process underlying the function of an intelligent machine. A model of a "neuron" is presented which exhibits properties of memory and learning. . . .

FINITE COUNTING AUTOMATA
M. P Schutzenberger, Inform. Control, vol. 5, no. 2, June 1962, p. 91/107.

The purpose of this note is to define a family . . . of sets of words that is, in some sense, the simplest natural generalization of the family . . . of Kleene's (1956) regular events . . .

MATHEMATICAL PROBLEMS OF MODERN CYBERNETICS
S. L. Sobole, et al., Joint Publications Research Service, San Francisco, Calif., JPRS: 16008, 2 Nov. 1962, 16 p., AD 299 174.

PRINCIPLES OF SELF-ORGANIZATION (Vol. 9)
H. Von Foerster and G. W. Zopf, Jr. (editors), New York, Pergamon Press, Inc., 1962, 560 p.

. . . transactions of the University of Illinois Symposium on self-organization held on June 8 and 9, 1961, under the sponsorship of Information Systems Branch, U. S. Office of Naval Research. . . . 23 papers . . . artificial intelligence, mechanization of thought, automation of perception . . .

PROCEEDINGS OF THE SYMPOSIUM ON MATHEMATICAL THEORY OF AUTOMATA, NEW YORK, N. Y., APRIL 24, 25, 26, 1962. MICROWAVE RESEARCH INSTITUTE SYMPOSIA SERIES, VOL. 12.
Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y., 1962, 640 p., AD 422 869.

SESSION ON MATHEMATICAL AND PHYSICAL-TECHNICAL PROBLEMS OF CYBERNETICS (In German)
Technik, vol. 17, no. 9, Sept. 1962, p. 648/650.

Abstracts of some of the lectures delivered at the session are presented. . . . definitions and limits of cybernetics were discussed. . . . mathematical methods in the optimization of automatic controls . . . self optimizing systems . . . learning machines, programming of computers, automatic traffic and linguistic problems in the automatic translation.

AUTOMATA AND EVENTS
V. G. Bodnarchuk, Joint Publications Research Service, Washington, D. C., Feb. 28, 1963, 36 p., refs. Transl. into English of an article from Vkr. Mat. Zh (Kiev), vol. 14, Oct. 1962, p. 351/361, JPRS-17879; OTS-63-21228, N64-10726.

. . . Two kinds of special automatic languages are investigated-the language proposed by Medvedev which is designated M, and the language employed by Glushkov which is designated K . . . A third language, R, is introduced to establish the relation between the languages M and K. The algorithm of Glushkov's synthesis is interpreted as a transition along the chain K R A, where A is the language of the automatic matrices.

TOWARDS THE MECHANIZATION OF MENTAL ACTIVITIES
S. Ceccato, et al., Milan U., Italy, RADC TDR63 528, 30 July 1963, 64 p., AD 427 084.

. . . construction of a machine that observes and describes the events of its surroundings and its internal events ("Talking Automation") . . . conceptual difficulties which a program of this type gives rise to

. . . block diagram of the machine and the scheme of the optical explorer with which the machine is equipped.

AUTOMATA AND SEQUENTIAL MACHINES, A SURVEY
H. Y. Chang, Coordinated Science Lab., Univ. of Illinois, Urbana, Rept. no. R168, June 1963, 39 p., AD 420 855.

A NEW CONCEPT IN ARTIFICIAL INTELLIGENCE
J. P. Choisser, et al., RADC, Information Processing Lab., Griffiss AFB, N. J., RADC-TDR-63-228, May 1963, 9 p., N63-18170.

. . . conceptual aspects of CHILD (Cognitive Hybrid Intelligent Learning Device). . . . is a self-adaptive learning machine. . . . adaptive learning devices will be viewed as networks of redundant adaptive elements which are capable of being organzied by some "learning" logic. The common function . . . here consists basically of a remapping of the sensory space in some manner which will enable decision elements to divide the remapped sensory inputs into various classes. . . .

HUMAN INFORMATION PROCESSING
M. Eden, IEEE Trans. Inform. Th., vol. IT-9, no. 4, Oct. 1963, p. 253/256, 60 refs.

ARTIFICIAL INTELLIGENCE RESEARCH
E. A. Feigenbaum, IEEE Trans. Inform. Th., vol. IT-9, no. 4, Oct. 1963, p. 248/253, 43 refs.

PATTERN RECOGNITION WITH SELF-ORGANNIZING MACHINES
A. C. Foreman, Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, AFIT GE EE 63 8, Aug. 1963, AD 419 094.

A STUDY OF GENERALIZED MACHINE LEARNING
W. H. Fuhr, Melpar, Inc., Fall Church, Va., Final technical rept., Feb. 1962 - June 1963, ASD TDR63 714, Aug. 1963, 228 p., AD 416 201.

The training process has been analyzed as a Markov process in a finite state machine . . . Methods are presented for calculating the mean learning time . . . The training process is investigated with both stationary and . . . an algebraic formulation of machine-environment interaction in a non-stationary environment is also presented . . .

SYMPOSIUM ON THE THEORY OF RELAY DEVICES AND FINITE AUTOMATA
M. A. Gavrilov, Joint Publications Research Service, Washington, D. C., May 29, 1963, 7 p., Transl. into English of an article from Vestn. Akad. Nauk SSSR., no. 4, April 1963, p. 85/88, JPRS-19483; OTS 63-21951, N64-10588.

THEORY OF PROBABILITY STATE VARIABLE SYSTEMS. VOLUME III. MONOTYPE SYSTEM THEORY AND CONSIDERATIONS FROM AUTOMATA THEORY
L. O. Gilstrap, et al., Adaptronics, Inc., Alexandria, Va., Final rept., 15 Oct. 1961-14 Oct. 1962, ASD TDR63 664, vol. 3, Dec. 1963, 141 p., AD 428 087.

. . . examined from two points of view. . . . first . . . that of automata theory and the problems of automaton environment interaction . . . Secondly, a detailed structural model of a generalized switching device . . . Novel mathematical methods for determining properties of the probability state variable device are developed. An index notation for logic problems is presented and some of the general properties of switching networks are analyzed using this notation.

THEORY OF PROBABILITY STATE VARIABLE SYSTEMS. VOLUME II: HISTORICAL DISCUSSION OF PSV DEVICES WITH EMPHASIS ON THE NEUROTRON
R. J. Lee, Adaptronics, Inc., Alexandria, Va., Final rept., 15 Oct. 1961 - 14 Oct. 1962, ASD TDR 63 664, vol. 2, Dec. 1963, 187 p., AD 428 099.

. . . defines their distinguishing features. . . . Most of these devices are able to learn logic functions, but the Neurotron combines logic with analog (gain-phase) functions, so that, in the Neurotron, logic, gain, and time-constants are all subject to learning.

SOME MEMORY ASPECTS OF FINITE AUTOMATA
C. L. Liu, Massachusetts Inst. of Tech., Research Lab. of Electronics, Cambridge, MIT-TR-411, May 31, 1963, 75 p., 4 refs., N63-18004, AD 409 580.

. . . the behavior of an automaton is dependent upon its past history. Several special cases are studied in which the unique determination of the behavior of an automaton is possible, even when a portion of its past history is unknown.

ON CYBERNETICS, INFORMATION PROCESSING, AND THINKING
M. E. Maron, RAND Corp., Santa Monica, Calif., Rept. no. P 2879, March 1964, 42 p., AD 435 484.

. . . to attack one aspect of the question of how a person thinks; i.e., the question of the information mechanisms and processes which underlie and are correlated with thinking. . . .

A CLASSIFICATION OF LEARNING TASKS IN CONVENTIONAL LANGUAGE (Final Report)
E. E. Miller, Wright-Patterson AFB, Ohio, Behavioral Sciences Lab., AMRL-TDR-63-74, July 1963. 20 p., 7 refs., N63-22594.

. . . Learning tasks are categorized by applying the definitional criteria sequentially. Major categories are perceptual-motor, discovery, understanding, perceptual judgment, and memorizing . . .

SELECTED ANNOTATED BIBLIOGRAPHY ON SYSTEMS OF THEORETICAL DEVICES
C. R. Mongtomery, Parke Mathematical Labs., Carlisle, Mass., Scientific Report No. 4, AFCRL-63-515; Sept. 1963, 51 p., refs., AD 425 691, N64-13622.

. . . (1) automata and self-duplicating machines; (2) logic, including computing and abstraction (3) neurosphysiological systems, including bionics and simulation; and (4) switching, including electrical systems . . .

PRINCIPLES OF ACCOMPLISHING LEARNING AND LOGICAL PROCESSES IN AUTOMATIC EQUIPMENT
P. Neidhardt, Joint Publications Research Service, Washington, D. C., May 10, 1963, 22 p., Transl. into English from Technik (E. Berlin), vol. 18, no. 4, April 1963, p. 277/281, JPRS-19134; OTS-63-21797, N64-10458.

A GUIDE TO THE GENERAL PROBLEM SOLVER PROGRAM
A. Newell, RAND Corp., Santa Monica, Calif., Memo no. RM-3337-PR, Feb. 1963, 148 p., AD 297 849.

Descriptors: Programming (Computers), Artificial intelligence, Communication theory.

LEARNING, GENERALITY AND PROBLEM SOLVING
A. Newell, RAND Corp., Santa Monica, Calif., Memo no. RM-3285-1-PR, Feb. 1963, 34 p., AD 298 949.

Descriptors: Learning, Programming (Computers), Pattern recognition.

STATISTICAL COMPUTATION AND STATISTICAL AUTOMATA
G. Pask, Systems Research Ltd., London (Gt. Brit.), 1963, 18 p., AD 408 196.

THE THEORY OF DEFINITE AUTOMATA
M. Perles, et al., IEEE Trans. Electronics Comp., vol. EC-12, no. 3, June 1963, p. 233/243.

A definite automaton is, roughly speaking, an automaton (sequential circuit) with the property that for some fixed integer k its action depends only on the last k inputs. The notion of a definite event introduced by Kleene, as well as the related concepts of definite automata and tables, are studied here in detail.

PROBABILISTIC AUTOMATA
M. O. Rabin, Inform. Control, vol. 6, no. 3, Sept. 1963, p. 230/245.

Probabilistic automata (p.a.) are a generalization of finite deterministic automata. . . . Here we develop a general theory of p. a. and solve some of the basic problems. . . . the results . . . bear on questions of reliability of sequential circuits. . . .

CYBERNETICS, A DDC REPORT BIBLIOGRAPHY
E. E. Thompson (comp.), Defense Documentation Center, Alexandria, Va., Bibliography for 1953-Sept 1963, Oct. 1963, lv., AD 419 462.

Annotated bibliography of 227 documents catalogued by DDC from 1953 to the present (includes and supersedes ARB-13, 453, dated December 1962) . . .

EXPERIMENTS WITH A THEOREM-UTILIZING PROGRAM
L. E. Travis, System Development Corp., Santa Monica, Calif., Rept. no. SP1402 000 01, 5 Feb. 1964, 48 p., AD 431 056.

. . . theorem-learning-and-utilizing program has been written and tested in simple but paradigmatic problem domains. . . . difficulties associated with pattern recognition . . .

FIRST CONGRESS ON THE INFORMATION SYSTEM SCIENCES, SESSION 8: INTELLIGENT AUTOMATA
Mitre Corp., Bedford, Mass., Rept. no. MITRE SS8, ESD TDR63 474 8, Oct. 1963, 30 p., AD 422 546.

. . . Time-sharing and space-sharing concepts, permitting the use of a computer by a number of people during the same period to reduce costs and attain higher speed, are explained. . . . advanced multi-users systems . . . Digital and analog computers are compared and problem solving techniques are covered . . . results of research in machine decision-making and in the processing and translation of languages by computers.

PRINCIPLES OF THE DESIGN OF SELF-LEARNING SYSTEMS
Joint Publications Research Service, Wash., D. C., JPRS: 18181, 18 March 1963, 187 p., 55 refs., AD 401 632.

PRINCIPLES OF THE DESIGN OF SELF-LEARNING SYSTEMS
Joint Publications Research Service, Washington, D. C., 21 Oct. 1963, 187 p., refs., Transl. into English of a collection of reports from "Printsipy Postroyeniya Samoobuchayushchiksya Sistem" (Kiev), 1962, JPRS-18181: OTS-63-21344, N64-11029.

Related Publications:

THE SIMULATION OF COGNITIVE PROCESSES, II: AN ANNOTATED BIBLIOGRAPHY
P. L. Simmons, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 535/552.

. . . a supplement to the annotated bibliography that appeared in these Transactions last year. . . . to add 460 references that were not then included. These additional references bring forward the cutoff date for the cited publications to June 1961, and expand the original bibliography by more than two hundred citations which were not available at the time the the first installment was compiled.

INTRODUCTION TO THE THEORY OF FINITE STATE MACHINES
A. Gill, New York, McGraw-Hill Book Co., 218 p.

. . . the author limits his attention to only a relatively small portion of the sequential machine area and his choice of material may not appeal to many of his readers . . .

PROGRAMS FOR MACHINE LEARNING. PART II
A. M. Hormann, System Development Corp., Santa Monica, Calif., Rept. no. SP1404, 13 July 1962, 23 p., AD 437 374.

. . . After surveying the task in general, the planning mechanism subdivides the task into a hierarchy of subtasks each by itself presumably easier to perform than the original task. This hierarchy of subtasks comprises a rough sketch of a possible course of action which guides the community unit.

THEORY OF ADAPTIVE MECHANISMS
M. K. Hu, et al., Syracuse U., Research Inst., N. Y., Rept. no. EE894 6307F, RADC TDR 63 334, Dec. 1963, 110 p., AD 429 935.

. . . four different but related tasks. . . . (1) Information Contents of Time Continuous Processes. (2) Visual Pattern Recognition by Moment Invariants. (3) Control and Communication Systems in the Blood. (4) Experiments on the Use of Threshold Logic for Learning Machines. . . .

COMPUTER SIMULATION OF HUMAN THINKING
A. Newell, et al., RAND Corp., Santa Monica, Calif., Rept. no. P2276, 20 April 1961, 23 p., AD 432 469.

. . . This use of computers for nonnumerical simulation of symbol-manipulating processes offers a solution to the dilemma that psychology has faced—that the problems of fundamental importance to the field have not always been those that existing research techniques were equipped to handle. Computer simulation promises to provide a powerful tool for constructing and testing theories of complex cognitive behavior.

ON CONTEXT-FREE LANGUAGES AND PUSH-DOWN AUTOMATA
M. P. Schutzenberger, Inform. Control, vol. 6, no. 3, Sept. 1963, p. 246/264.

This note describes a special type of one-way, one-tape automata in the sense of Rabin and Scott that idealizes some of the elementary formal features used in the so-called "push-down store" programming techniques. . . .

Section 3A.02

3A.020: Operational Computers in the U.S.A.

Included: Solomon computer; Pilot multiple computer system; UNIVAC; RCA 501; ATHENA; STRETCH; UNIVAC-LARC; GE-100; TRANSAC S-2000; IBM 7070; LN-3000; Honeywell H-290; HCM-202; ILLIAC-3.

Cross References: Operational computers outside the U.S.A. (3A.080); Organization of multiple computer systems (3A.130).

Principal Publications:

FASTER, FASTER
W.J. Eckert and R. Jones, McGraw-Hill Book Co., Inc., New York, 1955, 167 p.

. . . an attempt to explain in nontechnical language how a calculator operates, the nature of the problems it solves, and how the problems are presented to the calculator. Actually, it consists almost entirely of a description of "NORC", the Naval Ordnance Research Calculator designed and built by the International Business Machines Corporation.

THE IBM 7070 DATA PROCESSING SYSTEM
R.W. Avery, et al., Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 165/168.

. . . The main storage is magnetic core, backed by magnetic disks and tapes. Word length is ten decimal digits, but arithmetical operation times, being serial, are variable and depend on the length of the data. A feature of the machine is the extreme flexibility of peripheral equipment that may be attached to it.

THE GE-100 DATA PROCESSING SYSTEM
R. H. Hagopian, et al., Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 181/184.

The input equipment, processing equipment, and output equipment of the GE-100 bank checking account bookkeeping system are described.
The transistorized central processor operates in a series-parallel mode, using a 4000-word core memory. Memory-cycle time is 32μ sec and a single-address addition requires 64μ sec.

THE ATHENA COMPUTER, A RELIABILITY REPORT
L.W. Reid, et al., Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 20/24.

The high performance reliability which has been achieved in the Remington Rand Univac Athena Guidance Computer is discussed. . . . a large-scale general-purpose transistorized digital computer which is part of the Radio Inertial Guidance System for the Titan missile. Three Athena computers have been operated for 6361 hours with only 27 failures.

PERFORMANCE ADVANCES IN A TRANSISTORIZED COMPUTER SYSTEM: THE TRANSAC S-2000
R.J. Segal, et al., Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 168/174.

The system organization and the programming assembler-compiler, TAC, of the TRANSAC-S2000 are described.
The machine is equipped with index-registers, is all transistorized, and has a memory read-write cycle of 10μ sec with comparable speeds for arithmetical operations.

DESIGN OF THE RCA 501 SYSTEM
J.G. Smith, et al., Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 160/164.

The basic featurs of the RCA all-transistorized 501 Computing System are enumerated. Extremely high reliability results from the standaridized solid-state circuits. Failure rates of as low as one transistor failure per 1000 hours of system are claimed. Fast storage is variable word-length magnetic core with a cycle time of 15μsec, backed by a random access drum file and up to 63 tape units.

ENGINEERING DESIGN OF THE STRETCH COMPUTER
E. Block, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 48/58.

STRETCH, custom designed for Los Alamos, is without doubt the fastest and most complicated system now available. Among its salient features are:
A very large . . . 2-μ sec 64-bit core memory, . . . which allows a very high memory reference rate.
A look-ahead unit . . .
The possibility of operating on variable-length fields . . .
A very fast arithmetic unit . . .
An interrupt system . . .
An Exchange element, linking the memories to input/output, which runs independently of the central computer. . . .

DESIGN OF UNIVAC-LARC SYSTEM: I
J.P. Eckert, et al., Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 59/65.

Basically, the LARC system consists of a computer and a Processor: both units are controlled by stored program. The Processor handles input-output devices, does control input-output data conversion, editing, sorting and merging. The operation of the Processor is initiated by control words from the computer . . .

PILOT — A NEW MULTIPLE COMPUTER SYSTEM
A.L. Leiner, et al., J. Assoc. Comp. Mach., vol. 6, July 1959, p. 313/335.

. . . three interconnected computers contribute to an extremely fast, versatile and flexible system that can accept input and produce output in any convenient form. . . .

DESIGN OF UNIVAC-LARC SYSTEM: II
H. Lukoff, et al., Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 66/74.

This paper presents many of the engineering considerations in the design of LARC.

THE UNIVAC SOLID-STATE 80 COMPUTER
Univac Rev., vol. 2, no. 2, 1959, p. 4/5.

. . . With its large 50,000-digit drum memory and 17-microsecond word time, the machine is ideal for table look-up operations. Another feature is the biquinary code which enables the conventional 80-column card to be "stretched" to carry considerably more information than normal.

THE LN 3000 COMPUTER CONTROL SYSTEM
K.G. Harple, et al., Commun. and Electronics vol. 79, no. 50, Sept. 1960, p. 408/413.

. . . for continuous operation in an industrial process . . . Error detection and correction were incorporated through programming and logical design techniques. The computer in the system is able to monitor itself and the input-output equipment continuously for random errors and component failures. . . .

THE RCA 601 SYSTEM DESIGN
A.T. Ling, et al., Proc. Eastern Joint Comp. Conf., Dec. 1960, p. 173/177.

. . . all solid-state, modular, and asynchronous, with core memory and a general input-output control which may attach all the usual card, printer, paper and magnetic tape equipment and special-purpose devices, with simultaneity of up to 16 of these units with main frame processing. . . . Examples of asynchronous machine operation are given.

BENDIX G-20 SYSTEM
Commun. Assoc. Comp. Mach., vol. 3, May 1960, p. 325/328.

. . . general purpose, automatic data processing system . . . A standard routine called Monitor controls input-output operations, permits the concurrent operation of two or more programs, and automatically schedules the use of peripheral equipment on the basis of a priority program selected by the user.

A NEW APPROACH TO THE FUNCTIONAL DESIGN OF A DIGITAL COMPUTER
R.S. Barton, Proc. Western Joint Comp. Conf., May 1961, p. 393/396.

. . . discusses some of the fundamental principles on the basis of which the Burroughs B-5000 computer is organized. In particular the concept of the "stack" is described and its operational features illustrated by means of a very brief example and two tables.

LOGICAL ORGANIZATION OF THE HONEYWELL H-290
J.J. Eachus, Commun. and Electronics, vol. 79, no. 52, Jan. 1961, p. 715/719.

. . . provided with input and output paths which make it particularly casy to rclatc thc computcr to sensing and control devices. . . . is fully parallel, operating on an 18-bit word. . . . a core memory of 4,096 words, plus 8,192 words of drum storage. . . .

DESIGN OF THE ESIAC ALGEBRAIC COMPUTER
M. L. Morgan, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 524/529.

The concept of a pair of potential-plane "factor analogs," in which voltage measurements at the zeros and poles of a function are used for the calculation, is employed in the design of a general-purpose computer for algebraic functions of a complex variable. The logarithmic complex plane is used in order to represent a wide range of zeros and poles with uniform accuracy. Plotting facilities provide direct graphical output for applications such as frequency response plots and root-locus plots.

UNIVAC-LARC HIGH-SPEED CIRCUITRY: CASE HISTORY IN CIRCUIT OPTIMIZATION
N.W. Prywest, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 426/438.

PLANNING A COMPUTER SYSTEM
W. Buchholz (editor), New York, McGraw-Hill Co., Inc., 1962, 339 p.

. . . an edited collection of previous papers and other unpublished material describing the design of the IBM 7030 System better known as STRETCH.

HCM-202 THIN FILM COMPUTER
M.M. Dalton, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 536/541.

. . . the latest in a family of high performance parallel computers for aerospace application . . . advanced thin film construction . . . unique and highly flexible interconnection technique which has solved one of the major stumbling blocks to effective thin film construction of complex digital computers.

THE SOLOMON COMPUTER
D. L. Slotnick, et al., Proc. A FIPS Fall Joint Computer Conf., Dec. 1962, p. 97/107.

The Solomon (Simultaneous Operation Linked Ordinal Modular Network) is a problem-oriented computer system. The system is developed especially to solve problems involving sets of variables that permit simultaneous and identical operation on each individual variable within the set. To this purpose the system consists of many (e. g., 32 X 32) identical "processing elements" under control of a central processor.

EQUIPMENT MODIFICATIONS AND FEASIBILITY DEMONSTRATION FOR IMPROVEMENT OF THE PHASE I UNIVAC (trademark) ATC DATA-PROCESSING SYSTEM
Remington Rand Univac. Div., Sperry Rand Corp., St. Paul, Minn., Final Engineering Report., Sept. 1962, 18 p., N63-15815.

. . . four major problem areas: (1) real-time clock function, (2) data recovery, (3) data voiding by character and field, and (4) FAA system manual. . . .

THE ILLINOIS PATTERN RECOGNITION COMPUTER — ILLIAC III
B.H. McCormick, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 791/813.

This report describes the system design of an all-digital computer for visual recognition. One processor, the Pattern Articulation Unit (PAU), has been singled out for detailed discussion. Other units, in particular the Arithmetic Unit and the Taxicrinic Unit, are treated in reports listed in the bibliography.

THE SOLOMON COMPUTER
J. Gregory, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 774/781.

. . . This paper describes the final design of the computer, from a total system viewpoint. . . . consists of three major units. The processing element (PE) network, the network control unit (NCU), and the input-output unit (IOU).

PARALLEL NETWORK COMPUTER (SOLOMON)
Westinghouse Electric Corp., Baltimore, Md., Rept. no. 406A2, RADC TDR63 261, vol. 1, 15 April 1963, 136 p., AD 419 318.

. . .A brief introduction to the concept of parallel network computers is given. . . . logical and circuit design . . . machine operation . . . several problems programmed for the breadboard.

Related Publications:

FINGERS OR FISTS
W. Buchholz, Commun. Assoc. Computing Mach., vol. 2, Dec. 1959, p. 3/11.

A detailed comparison between the binary and decimal number system in regard to high-speed operations is carried out. After careful review, binary addressing and both binary and decimal arithmetic were incorporated in the STRETCH system.

Section 3A.08

3A.080: Operational Computers Outside the U.S.A.

Included: Ferranti-Perseus; Siemens 2002; ATLAS; STANISLAUS; MUSASINO-1; URAL; LEM-1; Philips-PASCAL; CIRRUS; D21 Saab computer; GIER; SABRAC; Telefunken TR-4; ZAM-41.

Cross References: Operational computers inside the U.S.A. (3A.020).

Principal Publications:

THE HIGH-SPEED ELECTRONIC CALCULATING MACHINE OF THE ACADEMY OF SCIENCES OF THE U.S.S.R.
S. A. Lebedev, J. Assoc. Comput. Mach., vol. 3, July 1956, p. 129/133.

A general description of the best known Russian computing machine, B.E.S.M., is given. The operative memory is a 1023-word cathode-ray tube memory, backed by a drum and tapes. Instructions are three-address with an average rate of 7000 to 8000 operations per second.

THE UNIVERSAL ELECTRONIC DIGITAL MACHINE (URAL) FOR ENGINEERING RESEARCH
I. I. Bazilevskii, J. Assoc. Comput. Mach., vol. 4, Oct. 1957, p. 511/519.

. . . 1024 words of drum memory backed by a 40,000-word tape memory and a basic timing of 6000 operations per minute. Operations are single-address and the word length is 36 bits. . . . intended primarily for scientific and engineering problems.

THE SIEMENS DIGITAL COMPUTER 2002
H. W. Gumin, Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 157/160.

. . . transistorized . . . general purpose decimal machine with a word length of 12 decimals plus sign and an average speed of 2000 operations per second. . . . three index registers . . . automatic address substitution, and fixed-and floating-point operations.

THE FERRANTI-PERSEUS DATA-PROCESSING SYSTEM
P. M. Hunt, Computer J., vol. 2, July 1959, p. 68/75.

. . . designed specifically for large-scale data handling operations . . . consists of sixteen word nickel delay lines, each word comprising 72 bits, divided into 12 alpha-numerical characters of 6 bits each.

LEM-1, SMALL SIZE GENERAL PURPOSE DIGITAL COMPUTER USING MAGNETIC (FERRITE) ELEMENTS
U. A. Machmudov, Commun. Assoc. Comp. Mach., vol. 2, Oct. 1959, p. 3/9.

. . . 30-kc, single-address, 15-bit binary computer which has a 1024-word operative memory of magnetic cores and a 7167-word permanent "capacitive" memory. . . . Switching is performed primarily with magnetic elements and selenium diodes.

THE PARAMETRON DIGITAL COMPUTER MUSASINO-1
S. Muroga, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 308/316.

Features of a large-scale digital computer with novel logical elements, the parametrons, are described. The machine, which is located at Musashino City, Tokyo, was named the MUSASINO-1, and has been in almost continuous operation since its completion in the spring of 1957.

THE FORMULA-CONTROLLED LOGICAL COMPUTER "STANISLAUS"
F. L. Bauer, Math. Comput., vol. 14, Jan. 1960, p. 64/67.

The design of a special-purpose computer for testing the validity of formulas of the propositional calculus is described.

DESIGN OF A HIGH SPEED PARALLEL SOLID STATE DIGITAL COMPUTER
I. C. Hinckfuss, et al., Proc. Instn. Radio Engrs. Australia, vol. 21, no. 9, Sept. 1960, 581/590.

The proposed design of a junction transistor digital computer for the Weapons Research Establishment is presented. . . . immediate access magnetic core store of 1024 32-bit words . . .

ATLAS - A NEW CONCEPT IN LARGE COMPUTER DESIGN
Commun. Assoc. Comp. Mach., vol. 3, June 1960, p. 367/368.

. . . new large-scale computer developed jointly by the University of Manchester and Ferranti, Ltd., . . .

THE PHILIPS COMPUTER PASCAL
H. J. Heijn, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 175/183.

. . . binary parallel computer with a word length of 42 bits, a clock-pulse repetition time of 1 1/2 μsec, performing, on the average, 60,000 operations per second. . . . Core storage is backed by a drum and by magnetic tape. . . .

USE OF SOVIET DIGITAL COMPUTERS
Joint Publications Research Service, Washington, D.C., JPRS: 16173, OTS63-13067, 14 Nov. 1962, p. 8, AD 299 048.

CIRRUS, AN ECONOMICAL MULTIPROGRAM COMPUTER WITH MICROPROGRAM CONTROL
M. W. Allen, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 663/671.

These facilities have been produced largely with microprogramming. The basic hardware is comprised of general purpose registers, a half-word arithmetic unit and two stores, all of which may be inter-connected with considerable flexibility.

GIER—A DANISH COMPUTER OF MEDIUM SIZE
C. Gram, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 629/650.

. . . brief review of the design (42-bit words, 1-k core store, 12-k drum store, 50-microsecond fixed point, 100-microsecond floating, add time) . . .

THE D21 DATA PROCESSING SYSTEM BY SVENSKA AEROPLAN AKTIEBOLAGET, SWEDEN
B. Langefors, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 650/662.

. . . uses simple system structure and fast circuits plus flexible memory and is thus adapted to the use of advanced software and easy application to diverse fields. . . . should enable efficient handling of both administrative data processing problems and engineering computations.

SABRAC—A NEW GENERATION SERIAL COMPUTER
M. Lehman, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 618/628.

. . . a 100-kc serial transistorized device designed, constructed and now operating in the laboratories of the Scientific Department of the Israel Ministry of Defense. Main storage is on a 5000-word magnetic drum . . .

OUTLINE OF THE LOGICAL DESIGN OF THE ZAM-41 COMPUTER
L. Lukaszewicz, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 609/612.

. . . is a medium-sized, high-speed, parallel, binary computer with the word length of 24 bits and the internal storage capacity from 8192 to 32,768 words. It is destined mainly for data processing, but it may also be used for scientific computations and for real-time control.

AN EXPERIMENTAL INCREMENTAL COMPUTER
K. Millington, J. Brit. Instn. Radio Engrs., vol. 25, no. 5, May 1963, p. 461/473.

. . . using time-shared equipment. The basic operation provides approximate numerical integration by adding rectangular areas. There are 45 integrators in the computer, the integrands being represented serially by up to 22 bits at a digit rate of 500 k/second. . . .

THE POST OFFICE ENGINEERING DEPARTMENT'S COMPUTER — ITS USE IN RESEARCH
W.E. Thomson, Post Off. Elect. Engrs. J., vol. 56, no. 2, July 1963, p. 133/135.

STRUKTUR UND ARBEITSWEISE DER TELEFUNKEN-DIGITALRECHENANLAGE TR 4 (Structure and Operation of the Telefunken Digital Computer TR 4) (In German)
E. Ulbrich, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 613/618.

. . . a high-speed computer . . . suitable for commercial as well as for technical and scientific applications. The central processing unit can communicate directly, without additional intervening elements, with the usual input and output devices. . . .

SOVIET CYBERNETICS TECHNOLOGY: II GENERAL CHARACTERISTICS OF SEVERAL SOVIET COMPUTERS
W.H. Ware, et al., RAND Corp., Santa Monica, Calif., Memo. no. RM 3797PR, Aug. 1963, 61 p., AD 414 793.

. . . first in the Soviet Union to be fully transistorized. Two analog computers, the MN-10 and MN-14, are also described . . .

R.R.E. JOURNAL NUMBER 49
Royal Radar Establishment (Gt. Brit.), April 1963, 75 p., AD 406 939.

This issue of the R.R.E. Journal is devoted entirely to articles describing the new general purpose computer RREAC, which has a comprehensive fixed-and floating-point order code, and is fully transistorized, using a ferrite core store. . . . RREAC has successfully completed a computation programmed in ALGOL, the language which most of its customers will use for programming their problems. . . .

DIVISION 3A.1
THEORY, ORGANIZATION AND OPERATION OF COMPUTER SYSTEMS

The design of special purpose data processing systems for space applications requires a detailed knowledge of computer systems theory and organization. In this division, the compilers assembled a large number of references which they hope will be helpful for this purpose. The literature in this area is much larger than this selection may suggest. However it is hoped that at least a few of the following references may be applicable whenever the bibliography is consulted with special problems in mind. Great care has been applied to select references to documents, which themselves will have a number of further references or which may guide the reader to other specialized sources of information in this area.

The division starts with an introductory section. Section 3A.11 reviews contributions to the theory of number systems, to approximation theory and to queueing theory, which are all of importance in the theory of computing systems. A special subdivision contains many references to numerical computation methods which deal with detailed mathematical problems of interest to space communications specialists.

Section 3A.12 contains references to fundamental and encyclopedic publications in switching theory. Some references to sequential switching systems are included here, but the reader is also advised to check with subdivision 3A.016 (automata) and with sequential detection methods in volume two. Bionics will be discussed in Volume 3B.

The further sections in this division deal with computer systems organization, computer languages, computer programming and with some phases of computer operation, i.e., with the man-machine problem and with reliability.

Section 3A.17 brings references to diagnostic procedures and to computer maintenance.

Section 3A.18 could be fifty time as large if all publications on the use of general purpose computers were included. The compilers selected references to special problems which may arise during the use of computers in the area of space communications and in related fields. No claim of completeness is made for this section; the available references may be considered as examples of the broad use of computers by space electronics specialists and of the problems which they are encountering.

Section 3A.10

3A.100: Trends in Computer Systems Research and Analysis

Included: Teaching computer fundamentals; Instructional aids to explain computers; Computer systems design research.

Not Included: Electronics research in general.

Cross References: Progress of computer technology (Sect. 3A.00).

Principal Publications:

HORIZONS IN COMPUTER SYSTEM DESIGN
W.F. Bauer, Proc. Western Joint Computer Conf., May 1960, p. 41/52.

. . . "Information systems" are singled out as the computer application area of the future. Such systems are characterized by continuous information and control exchange among humans, and computers and other devices.

INFORMATION PROCESSING BY DATA INTERROGATION
J. Atkin, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 181/187.

. . . technique is described in which a function is evaluated by rapid interrogation of the given data for the presence of combinations of data variables giving rise to values of the function which are of interest. . . .

TEACHING AID FOR GAMES THAT TEACH THE FUNDAMENTALS OF COMPUTER OPERATION (Correspondence)
D.S. Williams, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 415/416.

BIGGER COMPUTERS AND BETTER MATHEMATICIANS
R. Bellman, RAND Corp., Santa Monica, Calif., Rept. no. P2863, Feb. 1964, 6p., AD 429 984.

ESTABLISHMENT AND OPERATION OF A REGIONAL RESEARCH CENTER AT MIT FOR COMPUTER TECHNOLOGY AND RESEARCH IN BIOMEDICAL SCIENCES
W.A. Clark, et al., National Institutes of Health, Bethesda, Md., Final Report, 29 Oct. 1963, 158 p., refs., N64-19259.

. . . research in computer technology and to develop computer systems appropriate to problems in the biological and medical sciences . . . conduct coherent research programs in those areas of the biological and medical sciences in which the life scientists and the computer scientistis involved have overlapping interests . . .

ASSESSING COMPUTING SYSTEMS
L. Fein, Proc. On Line Data Processing Appl. Conf., Jan. 1963, p. 5/9.

. . . discusses four figures of merit for comparing computing systems: productivity, cost, effectiveness and worth. . . .

AN INSTRUCTIONAL AID FOR DIGITAL COMPUTER LOGIC
G.J. Lingwood, et al., J. Brit. Instn. Radio Engrs., vol. 25, no. 4, April 1963, p. 335/352.

. . . the function of basic digital computing elements may be demonstrated . . . elements may be combined to demonstrate the more complex circuits which are part of all digital computers. . . .

RESEARCH ON AUTOMATIC COMPUTER ELECTRONICS. VOL. III. SYSTEM DESIGN RESEARCH
R. I. Tanaka, Missiles Systems Div., Lockheed Aircraft Corp., Palo Alto, Calif., Final rept., 1 Sept. 1962-1Oct. 1963, RTD TDR 63 4173, vol. 3, Feb. 1964, AD 435 674.

. . . to lead to a rational integrated approach to the design of digital computer systems. . . . methods for advancing and automating some of the less undeveloped design steps. . . . literature survey on heuristic programming . . .

Section 3A.11: Theory of Machine Computation

3A.110: Theoretical Fundamentals of Numerical Calculation

Included: Binary number system; Binary coded decimal representation; Unitary (abacus) arithmetic procedure; Floating-point number representation; Significant digit arithmetic; Non-redundant residue systems; Sign detection procedure; Residue number systems; Sign Algebraic logic; Unnormalized arithmetic operations; Numerical methods for computers; Error propagation in machine computation; Modular arithmetic techniques; ALPAC system of nonnumerical alegbra, Flexible implementation of digital computer arithmetic.

Not Included: General mathematics; Efficient binary codes (2).

Cross References: Special numerical computation method (3A.116); Special use of scientific computers in space electronics (3A.180); Non-arithmetic data processing procedures (3A.140); Design of arithmetic units (3A.224); Dynamic programming (3A.115); Special algorithms (3A.140).

Principal Publications:

SIGNIFICANT DIGIT COMPUTER ARITHMETIC
N. Metropolis, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 265/267.

The usual floating point arithmetic makes error analysis difficult. This paper describes an alternative system which offers a means of analyzing floating point calculations more effectively and which also possesses certain advantages from an equipment standpoint.

SOME ASPECTS OF THE LOGICAL AND CIRCUIT DESIGN OF A DIGITAL FIELD COMPUTER
I.F. Brown, et al., Electronic Engng., vol. 31, Oct. 1959, p. 590/592.

The principles of a new type of digital computer for the solution of field problems are described. . . . A unitary (abacus) rather than binary or decimal arithmetic is used.

FINGERS OR FISTS
W. Buchholz, Commun. Assoc. for Computing Mach., vol. 2, Dec. 1959, p. 3/11.

A detailed comparison between the binary and decimal number systems in regard to high-speed operations is carried out.

THE RESIDUE NUMBER SYSTEM
H. L. Garner, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 140/147.

. . . the arithmetic operations of addition, subtraction and multiplication may be executed in the same period of time without the need for carry. The main difficulties of the residue code pertain to the determination of the relative magnitude of two residue . . . and to the division process. . . . probably not suitable for general purpose computation but is suitable for a special class of control problems.

AN ELECTRONIC DIGITAL COMPUTER BASED ON THE '-2' SYSTEM (In Polish)
Z. Pawlak, Bull. Acad. Polon. Sci. Ser. Sci. Tech., vol. 76, Oct. 1959, p. 713/721.

CASTING OUT THREES IN BINARY NUMBERS (Correspondence)
J.H. Germeroth, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 373.

Rothstein has described a method for determining the least non-negative residue modulo three of a number expressed in binary notation. This note describes a method for determining this residue which is somewhat less intricate in its application, and which appears more tractable to mechanization.

NUMERICAL METHODS FOR HIGH SPEED COMPUTERS
G.N. Lance, London, England, Iliffe and Sons Ltd., 1960, 166 p.

. . . Evaluation of functions; Solution of ordinary differential equations; Matrix methods; The numerical solution of partial differential equations . . . Floating-point arithmetic . . .

NEW TECHNIQUES IN RESIDUAL ARITHMETIC
M. Levine, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 183/189.

. . . describes the use of a composite modular arithmetic number system to be called Residual Number System for Computers. . . . requires no carries between digits and so allows single step, parallel, arithmetic operations for addition, subtraction and multiplication. . . .

BINARY ARITHMETIC
G.W. Reitwiesner, In: Advances in Computers, F.J. Alt, editor, New York, Academic Press Inc., 1960, p. 231/308.

UNIQUENESS OF WEIGHTED CODE REPRESENTATIONS
G.P. Weeg, IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 487/489.

. . . This paper produces a necessary and sufficient condition on the weights of a weighted code for the unique representation of each digit by a sum of the specified form. Further, all possible sets of weights are displayed.

SUMMER INSTITUTE FOR SYMBOLIC LOGIC SUMMARIES (Cornell University, 1957) (2nd ed.)
Communications Res. Div. Inst. for Defense Analyses, Princeton, N.J., July 1960

This volume has 83 articles, 17 of which are in the fields of switching theory, theory of automata, computer design and computer programming, and will be reviewed here.

SIGNED-DIGIT NUMBER REPRESENTATIONS FOR FAST PARALLEL ARITHMETIC
A. Avizienis, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 389/400.

. . . The paper discusses the properties of signed-digit representations and arithmetic operations with signed-digit numbers; addition, subtraction, multiplication, division and round-off.

THE USE OF INDEX CALCULUS AND MERSENNE PRIMES FOR THE DESIGN OF A HIGH SPEED DIGITAL MULTIPLIER
A.S. Fraenkel, J. Assoc. Comp. Mach., vol. 8, Jan. 1961, p. 87/96.

This paper considers the application of indexes to computer arithmetic. Particular emphasis is given to the problem of multiplication.

AUFZAHLBARKEIT, ENTSCHEIDBARKEIT, BERECHENBARKEIT. EINFUHRUNG IN DIE THEORIE DER REKURSIVEN FUNKTIONEN (Enumerability, Decipherability, Compatability) (In German)
H. Hermes, Berlin, Springer-Verlag, 1961, 246 p.

A BASIS FOR A MATHEMATICAL THEORY OF COMPUTATION (Preliminary Report)
J. McCarthy, Proc. Western Joint Comp. Conf., May 1961, p. 225/288.

. . . techniques should be extremely useful as fragments of languages intended for communication between man and machine, and between man and man. . . . interest to designers of compiler languages, originators of formal logistic systems. . .

THEORY OF THE TRANSMISSION AND PROCESSING OF INFORMATION
A.G. Vitushkin, Oxford, England, Pergamon Press Limited, 1961, 230 p.

. . . defines mathematically the concept of the complexity of a tabulation problem. . . . "Theory of Transmission" represents in clear and concise terms the Soviet thinking in this field. . . .

CONVERSION FROM CONVENTIONAL TO NEGATIVE-BASE NUMBER REPRESENTATION (Correspondence)
L.B. Wadel, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 779.

THE MANIAC III ARITHMETIC SYSTEM
R. L. Ashenhurst, Proc. AFIPS Spring Joint Computer Conf., May 1962, p. 195/202.

. . . particular mode of computation termed significant-digit arithmetic. . . .

FLEXIBLE IMPLEMENTATION OF DIGITAL COMPUTER ARITHMETIC
A. Avizienis, JPL Space Progr. Summ., vol. 4, no. 37-16, June/July 1962, p. 95/98.

. . . description of a new method for the implementation of arithmetical operations in a digital computer. The previous parts have appeared in RS 36-12, Vol I, p. 46/49, and in RS 36-14, p. 27/31. . . .

ON A FLOATING-POINT NUMBER REPRESENTATION FOR USE WITH ALGORITHMIC LANGUAGES
A.A. Grau, Commun. ACM, vol. 5, March 1962, p. 160/161.

. . . defined such that fixed point numbers are a subset of the floating point numbers. . . .

ALGEBRAIC LOGIC
P.R. Halmos, New York, Chelsea Publishing Co., 1962, 271 p.

. . . results center around statements concerning refutable propositions rather than provable positions.
The entire material of the book has already appeared, in widely dispersed journals, between the years 1954 and 1959.

COMPUTER ARITHMETIC
H. Jacobowitz, New York, John F. Rider Publisher, Inc., 1962, 120 p.

DIVISION AND OVERFLOW DETECTION IN RESIDUE NUMBER SYSTEMS
Y.A. Keir, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 501/507.

SIGN DETECTION IN NONREDUNDANT RESIDUE SYSTEMS
N. Szabo, IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 494/500.

. . . general theorem is derived establishing necessary conditions for sign detection, and the use of this theorem is demonstrated through specific examples.

A METHOD OF INCREASING THE NUMBER OF ORDERS IN A DIGITAL COMPUTER (Correspondence)
G.W. Taylor, IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 416.

In a binary digital computer, the number of orders available is equal to 2^N, where N is the number of bits in the operation-code part of the instruction word.

CLOSED FORM SOLUTION TO CONTROL EQUATIONS
J. F. Andrus, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala., July 30, 1963, 22 p., 2 refs., N63-23030.

. . . shows how one may avoid the unreasonably small step size required for the numerical integration of some systems of linear, ordinary, differential w equations with nearly constant coefficients . . .

MODULAR ARITHMETIC TECHNIQUES
E.N. Belland, et al., Lockheed Aircraft Corp., Sunnyvale, Calif., Final rept., 1 July 1961-31 Oct. 1962, ASD TDR 62-686, Rept. no. 2-38-62-1, Jan. 1963, 232 p., AD 298 580.

THE ALPAK SYSTEM FOR NONNUMERICAL ALGEBRA ON A DIGITAL COMPUTER — I: POLYNOMIALS IN SEVERAL VARIABLES AND TRUNCATED POWER SERIES WITH POLYNOMIAL COEFFICIENTS
W.S. Brown, Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2081/2119.

. . . first of two papers on the ALPAK system for nonnumerical algebra on a digital computer . . .

ERROR PROPAGATION
J.N. Jamieson, Radio Corp. of America, Patrick AFB, Fla., In AF Missle Test Center New Data Reduction Methods to Improve Range Data, 1963, p. 7/16, N64-15313.

The random errors known to exist in a measuring device are propagated through the mathematical model of the device to the final measurements, so that estimates of the errors in the data to be expected can be obtained when future measurements are taken. This is commonly referred to a geometric dilution of precision (GDOP). A description of the theory and the methods of computation are given.

SYSTEMS APPROACH TO THEORY OF COMPUTING SYSTEMS
M.D. Mesarovic, IEEE Trans. Mil. Electronics, vol. MIL-8, no. 2, April 1964, p. 94/102.

A formal system is introduced which is capable of representing a universal Turing machine. This enables the input, state-output representation of the computing systems that allows the study on a unified basis of the larger systems involving computer like subsystems. . . .

BASIC OPERATIONS IN AN UNNORMALIZED ARITHMETIC SYSTEM
N. Metropolis, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 896/904.

A particular set of unnormalized arithmetic operations termed "basic" are described, in the context of the University of Chicago Maniac III Computer. Each basic operation involves three operand words and generates two result words, all in unnormalized floating point format. The use of these operations in the implementation of multi-precision arithmetic is explained; in particular, it is demonstrated that multiprecision division can be effected in a nontentative manner with their aid.

NEGATIVE-BASE NUMBER-REPRESENTATION SYSTEMS
G. F. Songster, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 274/277.

Number-representation systems employing negative bases, and identical in structure to the usual systems using positive bases, can represent both positive and negative numbers with equal facility. Arithmetic involving both positive and negative operands can also be performed in a negative-base system without special attention to the negative numbers.

SOME OPTIONS IN THE DESIGN OF A RESIDUE ARITHMETIC COMPUTER
R.I. Tanaka, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 123/130.

This paper discusses some of the options unique to the design of a computer in which the arithmetic unit is based upon the residue number system . . . Typical of such options are: size of moduli, number of moduli, method for representing sign, and coding of numbers. . . .

THE WHOLE-NUMBER-INCREMENTAL COMPUTING ALGORITHM
H. Wyle, IEEE Internat. Conv. Rec., Pt. 4, vol. 11, March 1963, p. 58/63.

. . . overcomes the resolution limitation in conventional DDA computers, and can lead to an extremely simple special-purpose computer. In its pure form, the algorithm is applicable to the solution of linear differential equations with constant coefficients by the updating method. . . . By permitting the temporary storage of several bits of overflow information, this computing technique can be applied to an entire navigation computation, including linear differential equations with variable coefficients. . . .

Related Publications:

THE APPLICATION OF A NEGATIVE BASE NUMBER SYSTEM TO A DIGITAL DIFFERENTIAL ANALYZER (In Polish)
Z. Pawlak, Bull. Acad. Polon. Sci. Ser. Sci. Tech., vol. 8, Feb. 1960, p. 149/150.

This short paper suggests that a number system to the base '-2' has certain advantages over conventional DDA number systems, especially with regards to the generation of three-valued (as vs two-valued) increments.

A FLOATING POINT ARITHMETIC UNIT
L.J. Bental, Electronic Engrg., vol. 34, March 1962, p. 144/147.

Conversion of the National-Elliott 803 transistorized general purpose digital computer from fixed point binary to floating binary point operation is described.

AREA TRANSFORMS
W.M. Brown, IRE Trans. Circuit Theory, vol. CT-9, no. 2, June 1962, p. 163/168.

. . . presents the theory of an operational calculus which is much more general than previously available theories. . . . introduction reviews the foundations of operational analysis and then leads quite naturally to area transforms as the most general form.

MATHEMATICAL STRUCTURE OF NON-ARITHMETIC DATA PROCESSING PROCEDURES
L. Lombardi, J. ACM, vol. 9, Jan. 1962, p. 136/159.

The basic elements of a theory of files are defined. In particular, an Algebraic Data Processing Language which allows the use of mathematical methods for describing nonnumerical information procedures is formulated. This "Boolean algebra of files" enables a data-processing problem to be described accurately in a precise way.

DYNAMIC PROGRAMMING: A BIBLIOGRAPHY OF THEORY AND APPLICATION
R. Bellman, et al., RAND Corp., Santa Monica, Calif., Memo. no. RM3951PR, Feb. 1964, 145 p., AD 429 915.

3A.115: Queueing Theory and Related Mathematical Disciplines

Included: Stochastic service systems; Traveling salesman problem; Transportation model; Priority queues; Constant service queue; Linear programming; Transient queue; Dynamic programming; Optimum priority classification; Birth and death queueing models; Single server queue; Job shop-like queueing systems.

Not Included: Queueing problems in large communications networks; Traffic loaders (1); Message queueing in communications links (2).

Cross References: Programming of computer systems (3A.150).

Principal Publications:

MATHEMATICAL METHODS IN THE THEORY OF QUEUEING
A.Y. Khintchine, New York, Hafner, 1960, 120 p.

. . . introduction to the theory of queues . . . exposition is . . . clear and the book should be accessible to "anyone who has mastered the main concepts of the theory of probability and followed some course however short in mathematical analysis."

ANALYSIS OF A BASIC QUEUING PROBLEM ARISING IN COMPUTER SYSTEMS
P.E. Boudreau, et al., IBM J. Res. Developm., vol. 5, April 1961, p. 132/140.

PROBLEMS AND METHODS OF LINEAR PROGRAMMING (In Russian)
D. B. Yudin, Ye. G. Gol'dshteyn, Moscow, Izdatel'stvo, Sovetskoye Radio, 1961, 492 p.

. . . presents a detailed examination of a wide class of problems requiring the application of modern mathematical procedures. Each of the discussed problems is presented in formal language and described as a matehematical problem in linear programming. . . .

SOME QUEUING PROBLEMS WITH BALKING AND RENEGING - 1
C. J. Ancker, Jr., et al., System Development Corp., Santa Monica, Calif., Sept. 14, 1962, 26 p., 9 refs., N63-15821.

A NONLINEAR DIGITAL OPTIMIZING PROGRAM FOR PROCESS CONTROL SYSTEMS
R. A. Mugele, Proc. A FIPS Spring Joint Computer Conf., May 1962, p. 15/32.

. . . succinct review of the status and techniques of nonlinear programming. . . . conclusions as to what are apparently the better ways to approach on-line nonlinear programming problems as are likely to occur in process control systems.

STOCHASTIC SERVICE SYSTEMS
J. Riordan, New York, John Wiley and Sons, Inc., 1962, 139 p.

. . . systems with loss and systems with delay. . . . written for the applied mathematician. . . . It is not an introduction. . . .

QUEUING THEORY (In Russian)
V. Ya. Rozenberg and A. I. Prokhorov, Moscow, Sovetskoye Radio Press, 1962, 256 p.

QUEUEING WITH RENEGING AND MULTIPLE HETEROGENEOUS SERVERS
C. J. Ancker, Jr., et al., System Development Corp., Santa Monica, Calif., Jan 21, 1963, 36 p., 8 refs., Presented at the 19th Natl. Meeting of the Operations Research Soc. of America, Chicago, May 1961, N63-15908.

A Poisson stream of items arrives at a multiple, parallel serving facility consisting of s heterogeneous servers. The service time-density functions are all negative exponential and may all have different means. An arrival balks (refuses to enter) if the queue size is equal to N. If the queue size is less than N, the arrival enters the queue and is served on a first-come first-served basis unless it reneges (leaves the queue). . . .

THE DUAL METHOD AND THE METHOD OF BALAS AND IVANESCU FOR THE TRANSPORTATION MODEL
A. Charnes, et al., Northwestern U., Evanston, Ill., Dec. 1963, 20 p., refs., N64-16863.

The problem of determining the optimal solution for the distribution of a transportation problem, when the quantities available at the origins and required at the destinations are variable, is discussed . . .

LINEAR PROGRAMMING AND EXTENSIONS
G. B. Dantzig, RAND Corp., Santa Monica, Calif., Aug. 1963, 635 p., refs., AD 418 366, N64-13093.

. . . the linear programming concept . . . formulating a linear programming model . . . the simplex method . . . pivoting, vector spaces, matrices, and inverses; the simplex method using multipliers . . . price concept in linear programming . . . the classical transportation problem. . .

TIME INTERVAL RANDOM VARIABLES FOR A CLASS OF TWO DIMENSIONAL QUEUES
R. V. Evans, Numerical Analysis Research, Univ. of California, Los Angeles, Research rept. no. 86, Oct. 1963, 21 p., AD 422 410.

. . . computation of the moments of waiting time, service time and departure interval for a class of two dimensional queues. . . .

THE STRUCTURE OF SOME TWO DIMENSIONAL QUEUEING SYSTEMS
R. V. Evans, California U., Los Angeles, July 1963, 24 p., AD 411 380.

. . . A method for concisely stating the problems for numerical work is developed. Solution of the basic quadratic equation in matrices is discussed, and a condition which guarantees convergence of an iterative procedure is found. Formulas for means and variances are constructed . . .

NOTE ON THE BUSY PERIOD IN THE CASE OF INFINITE MEANS
H. Hanisch, et al., Courant Inst. of Mathematical Sciences, New York U., N. Y., Rept. no. IMM NYU 309, June 1963, 8 p., AD 412 476.

We consider in this note an ordinary single server queue in which the service time of the first customer is an arbitrary constant b, the service times of succeeding customers are independent . . .

PROPERTIES OF A TRANSIENT QUEUE
H. Hanisch, et al., Courant Inst. of Mathemathematical Sciences, New York Univ., New York, May 1963, 17 p., AD 435 025.

JOBSHOP-LIKE QUEUEING SYSTEMS
J. R. Jackson, California U., Los Angeles, Feb. 1963, 12 p., AD 433 229.

The equilibrium joint probability distribution of queue lengths is obtained for a broad class of jobshop-like "networks of waiting lines," where the mean arrival rate of customers depends almost arbitrarily upon the number already present, and the mean service rate at each service center depends almost aribtrarily upon the queue length there.

A SOLUTION OF THE TRAVELING-SALESMAN PROBLEM BY INTEGER LINEAR PROGRAMMING
V.I. Mudrov, Joint Publications Research Service, Washington, D.C., In its Math. Solutions for Transport Probl., 27 Jan. 1964, p. 44/48, ref., N64-16229.

TABLE OF THE WAITING TIME DISTRIBUTION FOR THE CONSTANT SERVICE QUEUE (M/D/1)
R.M. Oliver, California U., Berkeley Operations Research Center, 30 Sept. 1963, 25 p., refs., AD 426 483, N64-14762.

The single channel, constant-service queue with Poisson arrivals represents one of a variety of mathematical models in which customers demand service at a single facility . . .

ON THE PROBLEM OF OPTIMUM PRIORITY CLASSIFICATION
R. M. Oliver, et al., Operations Research Center, U. of Calif., Berkeley, Rept. no. 63 29 RR, 30 Dec. 1963, 26 p., AD 434 807.

In certain traffic and storage operations many types of customers use a common service facility. At an airport runway, for example, landings and departures may consist of many types and sizes of propeller and jet aircraft, each with different service characteristics. It is often possible to assign each customer to a priority class . . . and devise an ordered servicing rule . . .

PRIORITY QUEUES
L. Takacs, Columbia U., New York, N.Y., 3 Oct. 1963, 23 p., refs., AD 429 065, N64-14833.

Customers of different priorities are arriving at a counter in accordance with a Poisson process. The customers are served by a single server in order of priority and for each priority in order of arrival. . .

FROM BALLOT THEOREMS TO THE THEORY OF QUEUES
L. Takacs, Columbia Univ., New York, Rept. no. 41 64, 2 March 1964, 35 p., AD 436 662.

A discussion is presented of a single-server queue with Poisson input and general service times and illustrates that all important problems concerning the queue size, the waiting time andand the busy period can be solved in an elementary way by using only two generalizations of the classical ballot theorem.

A SINGLE-SERVER QUEUE WITH FEEDBACK
L. Takacs, Bell Syst. Tech. J., vol. 42, no. 2, March 1963, p. 505/519.

. . . In this paper we shall determine for a stationary process the distribution of the queue size size as well as the Lapiace-Stieltjes transform and the first two moments of the distribution function of the total time spent in the system by a customer.

OPTIMAL M-STAGE PRODUCTION SCHEDULES WHEN NO PASSING IS PERMITTED
O.F. Teuton, Jr., Texas Technological College, Lubbock, Master's Thesis, June 1963, 121 p., AD 298 093.

SOLUTIONS TO THE J JOB M MACHINE SEQUENCING PROBLEM WITH DUE DATES
J.C. Whatley, Texas Technological Coll., Lubbock, May 1964, 82 p., AD 432 716.

PROBLEMS OF STATISTICAL INFERENCE FOR BIRTH AND DEATH QUEUEING MODELS
R. W. Wolff, Operations Research Center, U. of Calif., Berkeley, Rept. no. ORC 63 3 RR, 25 March 1963, 32 p., AD 412 934.

A large sample theory is presented for birth and death queueing processes which are ergodic and metrically transitive. . . .

METHODS FOR PREDICTING SYSTEM PERFORMANCE
Sylvania Electric Products, Inc., Waltham, Mass., Rept. no. F3050 1, ESD TDR 63 62 7, Oct. 1963, 93 p., AD 431 196.

Queueing aspects of four Command and Control Systems and one large communications system are discussed. The applicability of state of the art queueing theory techniques to analyses of Command and Control Systems is demonstrated . . .

DYNAMIC PROGRAMMING TECHNIQUES
Sylvania Electric Products, Inc., Waltham, Mass., Final rept., Rept. no. F2030 1, RADC TDR 64 10, 11 Dec. 1963, 108 p., AD 433 897.

The general theory of the recursive formulation of optimization problems is developed in this report. . . . the distinction between deterministic and nondeterministic programming problems is included. . . . Problems discussed include the optimum scheduling of link-to-satellite assignments in a nonsynchronous satellite communication system and the computation of optimum discrete allocations.

Related Publications:

ON SWITCHING PROBLEMS REQUIRING QUEUING THEORY IN COMPUTER-BASED SYSTEMS
M. Eisen, IRE Trans. Commun. Syst., vol. CS-10, no. 3, Sept. 1962, p. 299/303.

. . . The data to be processed is entered at . . . terminal sets which are remotely located from the computer. The information is then transmitted over low-speed lines to a terminal exchange where lines from many terminal sets meet. Here high-speed lines transmit the information to the computer where it is processed. The resulting information is sent back to the terminal sets. . . .

OPTIMIZATION OF NETWORK CONFIGURATIONS THROUGH QUEUEING THEORY
F. P. Randazzo, Elect. Commun., vol. 38, no. 4, 1963, p. 511/523.

. . . describes a generalized queueing theory model that can be used to perform traffic studies for the optimization of network configurations with respect to time and equipment costs. The model considers parameters such as time of input arrivals, priorities, variable processing rates, and variable traffic densities, and may be used for both steady-state and dynamic conditions. . . . assumes a Poisson input rate and exponential holding time. . . .

3A. 116: Special Numerical Computation Methods

Included: Solutions of algebraic equations; Root finding procedures; Functional equations; Interpolation methods; Solving simultaneous linear equations; Numerical application of Laplace transform; Differential equations; Numerical integration; Approximations theory; Asymptotic solutions; Extrapolation methods; Tchebycheff approximations; Converging factor of truncated series; Power series expansions; Co-variance matrix approximation.

Not Included: Basic mathematics.

Cross References: Special machine computation problems (3A. 182); Special algorithms (3A. 140).

Principal Publications:

MATHEMATICAL METHODS FOR DIGITAL COMPUTERS
A. Ralston and H. S. Wilf (editors), New York, John Wiley and Sons, Inc., 1960, 301 p.

. . . collection of twenty-six chapters by twenty-two authors—each concerned with one numerical solution process for a typical applied mathematics problem.

THE TWO VARIABLE EXPANSION PROCEDURE FOR THE APPROXIMATE SOLUTION OF CERTAIN NON-LINEAR DIFFERENTIAL EQUATIONS
J. Kevorkian, Douglas Aircraft Co., Inc., Santa Monica, Calif., Rept. no. SM42620, 3 Dec. 1962, 114 p., AD 426 822.

INTERPOLATION SPACES AND INTERPOLATION METHODS
N. Aronszajn, et al., Kansas U., Lawrence, Rept. no. TR3, Jan. 1964, 92 p., AD 430 756.

ON SUMS OF POWERS OF COMPLEX NUMBERS: AN IMPROVED ESTIMATE
F. V. Atkinson, Mathematics Research Center, U. of Wisconsin, Madison, Technical summary rept. 428, Dec. 1963, 32 p., AD 433 881.

POWER SERIES EXPANSIONS OF MATHIEU FUNCTIONS WITH TABLES OF NUMERICAL RESULTS
R. Barakat, et al., J. Math. Phys., vol. 42, Sept. 1963, p. 200/247, A63-24666.

. . . up to the fourth order . . . Expansions of the periodic and the modified functions are given. . . .

NUMERICAL SOLUTION OF FUNCTIONAL EQUATIONS BY MEANS OF LAPLACE TRANSFORM I: RENEWAL EQUATION
R. E. Bellman, et al., RAND Corp., Santa Monica, Calif., RM3948 NIH, Dec. 1963, 14 p., AD 426 719.

NUMERICAL SOLUTION OF FUNCTIONAL EQUATIONS BY MEANS OF LAPLACE TRANSFORM II: DIFFERENTIAL DIFFERENCE EQUATIONS
R. E. Bellman, et al., RAND Corp., Santa Monica, Calif., Rept. no. RM3952NIH, Dec. 1963, 9 p., AD 426 585.

A NUMERICAL INVERSION OF THE LAPLACE TRANSFORM
R. Bellman, et al., RAND Corp., Santa Monica, Calif., RM3513 ARPA; April 1963, 19 p., AD 405 873.

. . . A method applicable to the numerical analysis of the inverse Laplace transform is discussed. Numerical examples are given to illustrate this method.

COMPUTATIONAL ASPECTS OF APPROXIMATION THEORY
B. Boehm, RAND Corp., Santa Monica, Calif., Memo. No. RM4051 PR, Mar. 1964, 106 p., AD 433 175.

The theory of approximation by polynomials and rational functions is of considerable practical significance, due in great part to the efficiency of polynomials and rational functions in representing functions on a high-speed digital computer. Some of the more useful theoretical results are presented along with their interrelations and some of the practical consequences are pointed out. . . . algorithms for interpolation and for obtaining best least-squares and Chebyshev approximations. . . .

EXISTENCE, CHARACTERIZATION, AND CONVERGENCE OF BEST RATIONAL TCHEBYCHEFF APPROXIMATIONS
B. W. Boehm, RAND Corp., Santa Monica, Calif., Rept. no. R427PR, March 1964, 99 p., AD 432 186.

Some new results in the theory of rational Tchebycheff approximation are presented, and should be of interest to mathematicians and computer scientists.

APPROXIMATIONS FOR SOME RADIAL MATHIEU FUNCTIONS
J. E. Burke, Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs., EDL-M630, 1 Nov. 1963, 16 p. refs., AD 431 889, N64-16979.

APPROXIMATION THEORY
E. W. Cheney, California U., Los Angeles, Aug. 1963, 150 p., 102 refs., N63-23411.

. . . Various theorems, corollaries, and lemmas dealing with the approximation theory are presented and solved.

THE WILF STABILITY CRITERION FOR NUMERICAL INTEGRATION
G. Emanuel, J. Assoc. Comput. Machinery, vol. 10, Oct. 1963, p. 557/561, A64-11315.

PRACTICAL ASPECTS OF STATE-SPACE METHODS, PART I–SYSTEM FORMULATION AND REDUCTION
M. Enns, et al., IEEE Trans. Mil. Electronics, vol. MIL-8, no. 2, April 1964, p. 81/93.

NONLINEAR ORDINARY DIFFERENTIAL EQUATIONS: AN ANNOTATED BIBLIOGRAPHY
G. R. Evans, Lockheed Aircraft Corp., Sunnyvale, Calif., March 1963, 107 p., AD 403 790.

. . . existence and uniqueness of solution to ordinary differential equations of the following two classes of problems: initial value problems and boundary value problems. . . . chronological . . . 1949-Oct. 1962.

REPEATED EXTRAPOLATION TO THE LIMIT IN THE NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS
W. B. Gragg, California Univ., Los Angeles, Jan. 1964, 111 p., AD 434 254.

NEW METHODS OF SOLVING ALGEBRAIC EQUATIONS
K. H. Haase, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 560, Dec. 1963, 43 p., AD 427 882, N64-14661.

. . . A "Table Method" is devised by which oefficient approximations can easily be found. . . .

THE SOLUTION OF ALGEBRAIC EQUATIONS BY ROOT FINDING TABLES, PART I-INSTRUCTIONS
K. H. Haase, Air Force Cambridge Research Labs., Bedford, Mass., Data Sciences Lab., AFCRL-63-559 (1); Dec. 1963, 85 p., refs., AD 428 084, N64-16816.

THE SOLUTION OF ALGEBRAIC EQUATIONS BY ROOT FINDING TABLES PART II-POWER TABLE AND POLYNOMIAL TABLES
K. H. Haase, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 559, pt. 2, Dec. 1963, 115 p., AD 428 090, N63-16817.

Descriptions of a numerical technique which results in computer-generated contour maps . . . invaluable aid to subsequent exact investigation of a function's extrema by conventional numerical search techniques . . . may be used to generate stereographic views of a mathematical function. . . .

NTH ROOT COMPUTING METHODS
D. F. Martin, California U., Los Angeles, April 1963, 153 p., AD 404 716

Five main classes of nth rooting methods are discussed. . . . Hardware and storage requirements are considered in all cases.

THE CONVERGING FACTOR FOR THE EXPONENTIAL INTEGRAL
F. D. Murnaghan, et al., David Taylor, Model Basin, Washington, D. C., DTMB 1535, Jan. 1963, 103 p., AD 428 924.

. . . numerical tables referred to as "Power Table" and "Polynomial tables" are presented. . . .

ASYMPTOTIC SOLUTIONS OF SYSTEMS OF NONLINEAR DIFFERENCE EQUATIONS
W. A. Harris, Jr., et al., Archive for Rational Mechanics and Analysis, vol. 15, March 2, 1964, p. 377/395, 15 refs., A64-16177.

Presentation of the asymptotic characterization of bounded solutions of a system of nonlinear difference equations. An analytic solution of the equation in its set form is shown to exist, for which the formal solution is an asymptotic representation. . . .

OPTIMIZATION AND VISUALIZATION OF FUNCTIONS
G. A. McCue, AIAA Journal, vol. 2, Jan. 1964, p. 99/100, A64-13136.

The term "converging factor," is generally defined as the factor by which the final term of a truncated series must be multiplied to yield the remainder of the series. . . . Auxiliary tables are presented to permit the evaluation of the factor to comparable accuracy for intermediate values of the argument. . . .

EIN IMMER KONVERGENTES NULLSTELLENVERFAHREN FUR ANALYTISCHE FUNKTIONEN (An Always Convergent Method for Determining the Zeros of Analytic Functions) (In German)
K. Nasitta, Z. Angew. Math. Mechanik, vol. 44, Jan.-Feb. 1964, p. 57/63, A64-15702.

. . . always yields, for each point in the plane of complex numbers, a direction along which the absolute value of an analytical function decreases in such a way as to produce a strictly monotonous null sequence. A flow diagram devised for numerical calculations is presented and applied to an example.

SOME ITERATIVE TECHNIQUES FOR SOLVING SIMULTANEOUS LINEAR EQUATIONS
J. H. Nolen, Texas A & M College., College Station, May 1963, 73 p., AD 404 709.

. . . n-step versions of the Kaczmarz technique . . . convergence proof involving Gauss-Seidel iteration . . .

AN INDEX OF APPROXIMATIONS OF FUNCTIONS
B. Prasad, California Univ., La Jolla, Aug. 1963, 32 p., AD 424 809.

. . . The most important approximation techniques used are Maclaurin Power Series, Chebyshev Expansion, Modified Taylor's Expansion. Lanczo's -method, Pade's Method, Maehley's Method, Heuristic approach of Hastings.

AN INDEX OF APPROXIMATIONS OF FUNCTIONS
B. Prasad, California Univ., La Jolla, Rept. no. 64 02, Feb. 1964, 47 p., AD 434 195.

A summary of the rational and polynomial approximations of mathematical functions that are used in scientific computations is presented. . . .

NUMERICAL EVALUATION OF INTEGRALS AND SOLUTIONS OF INTEGRAL EQUATIONS
L. B. Rall, Mathematics Research Center, Univ. of Wisconsin, Madison, Technical summary rept. 461, Feb. 1964, 25 p., AD 433 947.

COVARIANCE MATRIX APPROXIMATION
L. B. Schlegel, AIAA Journal, vol. 1, Nov. 1963, p. 2672/2673, A63-25735.

Consideration of a useful approximation in error analyses involving trivariate normal distributions. The determinant of the covariance matrix of a trivariate normal distribution is a figure of merit which relates to error volumes in tracking prediction problems. In computing this determinant, neglect of the covariance elements leads to pessimistic estimates of system accuracy, hence is a safe approximation for preliminary analysis. . . .

FOURIER SERIES IN SEVERAL VARIABLES
V. L. Shapiro, Oregon U., Eugene, 27 Aug. 1963, 46 p., AD 434 319.

. . . survey of certain aspects of the theory of multiple Fourier and Trigonometric series. . . .

A BIBLIOGRAPHY ON FUNCTIONAL EQUATIONS
G. I. Targonski, Geneva U. (Switzerland) Annual summary rept. no. 1, 30 April 1963, 74 p., AD 414 115.

. . . papers and books up to the end of 1945, and a similar list from 1946 on . . . In this sense, every differential, difference, and integral equation is . . . a Functional Equation . . .

MITROVIC'S METHOD-SOME FUNDAMENTAL TECHNIQUES
G. J. Thaler, et al., Naval Postgraduate School, Monterey, Calif., Its Res. Paper No. 39, Jan. 1964, 94 p. refs., AD 431 900, N64-16597.

. . . there are many methods for evaluating the roots of a polynomial, called the "characteristic equation, "few of these methods are of significant advantage in engineering synthesis problems. Mitrovic's method, because it relates the root values to coefficient in a convenient graphical representation, provides a very useful approach to design.

COMPUTATION OF THE REPEATED INTEGRALS OF THE ERROR FUNCTION COMPLEMENT
W. R. Wilcox, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR-169(3240-10)TR-2, SSD TDR 63-3, 2 Jan. 1963, 15 p., AD 297 858.

Related Publications:

THE AVERAGING IN SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS
V. M. Volosov, Minneapolis-Honeywell Regulator Co., Minn., Military Products Group, 1962, 165 p. refs, Transl. into English, MH-Transl.-435, N64-11639.

. . . applied in the investigation of oscillating processes described by ordinary differential equations . . . theorems on averaging . . . examples appearing in physics and technology . . . solution of problems which utilize the computation of higher asymptotic approximations of the averaging method . . . calculations dealing with the computation of phases in oscillating processes, and periodic solutions are computed for certain self-oscillating systems.

CHEBYSCHEV EXPANSION OF THE SINE AND COSINE INTEGRALS
R. Barakat, et al., J. Math. Phys., vol. 42, Dec. 1963, p. 331/333, A64-15187.

Presentation of an alternative method of evaluation of sine and cosine integrals based on Chebyschev polynomials which offers considerable advantages over the method of Lowan. . . .

PROBLEMS ON MEROMORPHIC FUNCTIONS
A. Edrei, Syracuse U., N. Y., Final rept., 1 July 1959 - 30 June 1963, 3p., AD 427 526.

. . . Stress was placed on the study of Nevanlinna's theory, particularly the notion of "deficient value." Bibliographic data are included of papers written on this topic . . .

OB ASIMPTOTIKE RESHENII NEKOTORYKH SISTEM INTEGRAL'NYKH URAVNENII (Asymptotic Solutions of Certain Systems of Integral Equations) (In Russian)
A. I. Fel'dman, Akademiia Nauk, SSSR, Doklady, vol. 154, Jan. 1, 1964, p. 57/60, A64-15486.

. . . Particular attention is given to systems of Wiener-Hopf type equations, systems of dual integral equations, and their conjugate systems . . .

QUASI-MARTINGALES AND STOCHASTIC INTEGRALS
D. L. Fisk, Michigan State U., East Lansing, Tech. rept. no. 1, 2 Aug. 1963, 92 p., AD 414 838.

FACTOR ANALYSIS OF DATA MATRICES PART II
P. Horst, Washington U., Seattle, Dec. 1963, 139 p., AD 427 805.

. . . series of reports on rationales and techniques of matrix factoring which play an important role in multivariate analysis techniques. . . .

FACTOR ANALYSIS OF DATA MATRICES
P. Horst, Washington U., Seattle, March 1964, 179 p., AD 434 811.

. . . series of reports on rationales and techniques of matrix factoring which plays an important role in multivariate analysis techniques. . . .

FUNDAMENTAL INEQUALITIES FOR DISCRETE AND DISCONTINUOUS FUNCTIONAL EQUATIONS
G. S. Jones, Martin-Marietta Corp., Baltimore, Md., RIAS Div., RIAS-63-11, April 1963, 26 p., 9 refs., N63-19638.

A series of lemmas are presented, involving sums rather than integrals, which contain inequalities that can be used in the analysis of finite-difference equations and in more general discontinuous functional equations in essentially the same capacity as the inequalities of Gronwall's lemma are used in the theory of differential equations. . . .

NOVYI METOD V VEROIATNOSTNOI TEORII CHISEL (A New Method in the Probability Theory of Numbers) (In Russian)
E. V. Novoselov, Akademiia Nauk SSSR, Izvestiia, Seriia Matematicheskaia, vol. 28, March - April 1964, p. 307/364, 40 refs., A64-17122.

. . . theory makes it possible to obtain in a new way a great number of the known results from the theory of numbers, together with the new ones.

THE FUNCTION SPACE POINT OF VIEW IN TIME SERIES ANALYSIS
E. Parzen, Applied Mathematics and Statistics Labs., Stanford U., Calif., 29 March 1963, 37 p., AD 404 896.

ON FINDING QUADRATIC FACTORS OF POLYNOMIALS
A. G. Vacrous, Purdue U., Lafayette, Ind., June 1963, 142 p., refs., N63-23816.

. . . Few simple methods exist which permit the rapid determination, by hand calculation, of complex zeros of polynomials. One of these methods has been proposed by R. Oldenburger and consists in the repetition of a right to left synthetic division, the same method also being available for determining real zeros . . . The main purpose of this work has been the study of the convergence of Oldenburger's method . . .

Algebraic techniques of path finding and minimum path finding in graphs S. Okada, et al., Mitre Corp., Bedford, Mass., TM 3421, ESD TDR 63179, May 1963, 29 p., AD 407 791.

Section 3A.12

3A.120: Theory of Switching Systems

Included: Iterative arrays; State diagrams; Dynamic switching; Theory of sequential switching systems; Decomposition theory; Generalized tree circuit; Theory of finite state machines; Symmetric sequential systems; Cascade switching circuits; Iterative switching networks; Theory of threshold switching networks; Applied Boolean algebra; Combinational switching theory; Symbology for digital systems; Terminology of switching theory; Theory of connecting systems; Minimum state sequential systems; Boolean functions; Switching network synthesis; Linear graph theory; Minimal state machines; Signal flow graph techniques; Truth function.

Not Included: Communications switching centers; Multiplexing systems (2).

Cross References: Automata in general (3A.016); Logical networks (Sect. 3A.22).

Principal Publications:

PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM ON THE THEORY OF SWITCHING, PT. I AND II
Cambridge, Massachusetts, Harvard University Press, April 1957.

MINIMAL "SUM OF PRODUCTS OF SUMS" EXPRESSIONS OF BOOLEAN FUNCTIONS
S. Abhyankar, IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 268/276.

The problem of economical synthesis of circuits for digital computers leads to the problem of finding Boolean expressions of minimal length equivalent to a Boolean expression f. Previous authors restricted themselves to "sum of products" expressions; dualizing this gives "products of sums." The next more efficient step is to find minimal "sums of products of sums" expressions.

ANALYSIS OF SEQUENTIAL MACHINES II
D. D. Aufenkamp, IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 299/306.

Mealy's model of a sequential machine is assumed and a relation of "compatibility" of states is introduced to further the analysis of such machines. In the event that input restrictions exist it is often possible to effect combinations of states under this relation in addition to those permitted under equivalence of states, a relation previously studied. Compatibility of states is analyzed by an iterative technique, rigorously established, which makes it possible to determine readily connection matrices of simpler "compatible" machines.

ITERATIVE COMBINATIONAL SWITCHING NETWORKS — GENERAL DESIGN CONSIDERATIONS
E. J. McCluskey, Jr., IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 285/291.

An iterative network is a combinational switching circuit which consists of a series of identical "cells" or sub-networks; for example, the stages of a parallel binary adder. A formal design method for iterative networks is presented. This is similar to the flow table technique for designing sequential circuits.

FORMAL ANALYSIS AND SYNTHESIS OF BILATERAL SWITCHING NETWORKS
R. E. Miller, IRE Trans. Electronic Comp., vol. EC-7, no. 3, Sept. 1958, p. 231/244.

Formal procedures for the analysis and synthesis of two-terminal combination bilateral switching networks are presented. A bilateral switching network is one which contains only elements having the same switching transmission characteristic in both directions.

SOME PROPERTIES OF BOOLEAN EQUATIONS
N. Rouche, IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 291/298.

Solubility conditions for a set of Boolean equations are established, first with respect to one variable, then with respect to all variables. By consideration of relations between minimal terms, a simple matrix form is deduced for Boolean equations. Using finite group theory and the properties of the characteristic equation of the matrix, a classification is introduced for Boolean mappings and their iterations, to which corresponds a classification of sequential machines.

SWITCHING CIRCUITS AS TOPOLOGICAL MODELS IN DISCRETE PROBABILITY THEORY
J. N. Warfield, IRE Trans. Electronic Comp., vol. EC-7, no. 3, Sept. 1958, p. 251/252.

. . . to call attention to a substitution rule which can facilitate discussion in the related areas of information theory, switching theory, computers, and probability theory. The discrete probability theory and its notation is usually confusing to the beginner. It is believed that the scheme to be suggested will facilitate both presentation and understanding of the subject.

SYMBOLIC LOGIC AND INTELLIGENT MACHINES
E. C. Berkeley, New York, Reinhold Publishing Co., 1959, 208 p.

The principles, methods and purposes of symbolic logic and Boolean algebra are explained in this outstanding book. . . . proceeds from answers to simple, basic questions towards ideas and terms needed to understand the whole subject. . . .

A SYNTHESIS TECHNIQUE FOR MINIMAL STATE SEQUENTIAL MACHINES
S. Ginsburg, IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 13/24.

A method is presented which always yields a minimal state sequential machine satisfying a prescribed finite set of input-output sequences. An application is made to the case where a given sequential machine is to be reduced, by the merging technique, to a machine having the smallest number of states possible. Numerous examples are given.

SYNTHESIS OF MINIMAL-STATE MACHINES
S. Ginsburg, IRE Trans. Electronic Comp., vol. EC-8, no. 4, Sept. 1959, p. 441/449.

. . . The machine is constructed in the same manner as has commonly been done in the past in synthesizing a "primitive flow table". This contribution consists, not in describing a new method of synthesizing machines, but in showing that a particular instance of an established method yields a minimal-state machine.

A TECHNIQUE FOR THE REDUCTION OF A GIVEN MACHINE TO A MINIMAL-STATE MACHINE
S. Ginsburg, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 346/355.

. . . for reducing an arbitrary machine S as much as possible to a machine T which can do everything (from the input-output point of view) that S can do. Since the technique is always applicable, it is more powerful (although more cumbersome) than the well-known merging technique. Several examples are given.

BOOLEAN MATRIX EQUATIONS IN DIGITAL CIRCUIT DESIGN
R. S. Ledley, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 131/139.

A systematic digital computational method is given that involves the use of Boolean matrix equations for solving certain types of functional circuit design problems. . . .

SYMBOLIC LOGIC (Second edition)
C. I. Lewis, C. H. Langford, New York, Dover Publications, Inc., 1959, 514 p.

. . . The Boole-Schroder algebra; The logic of terms; The two-valued algebra. . . The logistic calculus of unanalyzed propositions . . . The general theory of propositions. . . .

LOGICAL MACHINE DESIGN II: A SELECTED BIBLIOGRAPHY
D. B. Netherwood, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 367/380.

The bibliography which appeared in the June, 1958, issue of these Transactions is extended to a total of 777 titles. The original format is retained, but in this supplement the scope of material is restricted to technical publications pertaining to the logical design of machines.

LOGIC MATRICES AND THE TRUTH FUNCTION PROBLEM
D. B. Netherwood, J. Computing Mach., vol. 6, July 1959, p. 405/414.

. . . classification of Boolean functions and the derivation of standard forms for them.

MINIMAL SEQUENTIAL MACHINES
D. B. Netherwood, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 339/345.

. . . A procedure for developing the aggregate of all sets of gates for such minimal machines is evolved, and the problem of selecting components for constructing machines is discussed.

MINIMIZING THE NUMBER OF STATES IN INCOMPLETELY SPECIFIED SEQUENTIAL SWITCHING FUNCTIONS
M. C. Paull, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 356/367.

Given a sequential switching function in the form of a flow table in which some of the entries are unspecified, the problem of reducing the number of rows in that flow table is extremely complex, and cannot, in general, be solved by any simple extension of the methods used for completely specified functions. An analysis of the problem is presented, and a partially enumerative solution is evolved.

APPLIED BOOLEAN ALGEBRA, AN ELEMENTARY INTRODUCTION
F. E. Hohn, New York, The Macmillan Co., 1960, 159 p.

. . . presents the basic facts of Boolean algebra and describes some of its applications—in particular, applications to switching circuits. . . .

SUMMER INSTITUTE FOR SYMBOLIC LOGIC SUMMARIES (Cornell University, 1957) (2nd ed.)
Communications Res. Div. Inst. for Defense Analyses, Princeton, N. J., July 1960.

This volume has 83 articles, 17 of which are in the fields of switching theory, theory of automata, computer design and computer programming, and will be reviewed here.

PROPOSED SYMBOLOGY FOR DIGITAL SYSTEMS
Ad Hoc Group, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 629.

Summary only.

This report has been prepared as an urgently needed reference in three application fields; (1) algebraic symbols used in logical expressions, (2) graphical logic symbols for manually prepared logic diagrams, (3) printed graphical symbols for logic diagrams prepared by high speed printers. A uniform symbology is proposed that will carry unchanged meaning from design to maintenance. . . .

A DICTIONARY OF SWITCHING THEORY TERMS
Ad Hoc Group, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 630.

Summary only.

To facilitate the spread of knowledge in the field of switching theory, an ad hoc group of the AIEE Computing Devices Committee is preparing a dictionary of relevant terms.
The present report consists of a list of terms, some with definitions and some without, which is intended to illustrate the nature of the proposed work. . . .

DELAYED LOGIC AND FINITE STATE MACHINES
D. Arden, Proc. AIEE 2nd Annual Symp. Switching Circuit Theory, Oct. 1961, p. 133/152.

GEOMETRIC MAPPING OF SWITCHING FUNCTIONS
M. E. Arthur, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 631/637.

. . . A graphic representation, using vectors, of the conditions desired in the design of switching networks. This mapping technique makes the well-known techniques such as Boolean algebra, the Quine-McCluskey minimization chart, and Huffman's flow table more effective when designing optimum circuits.

COMPUTER DESIGN OF MULTIPLE-OUTPUT LOGICAL NETWORKS
T. C. Bartee, IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 21/30.

An important step in the design of digital machines lies in the derivation of the Boolean expressions which describe the combinational logical networks in the system. Emphasis is generally placed upon deriving expressions which are minimal according to some criteria. A computer program has been prepared which automatically derives a set of minimal Boolean expressions describing a given logical network with multiple-output lines.

LINEARLY SEPARABLE SWITCHING FUNCTIONS
C. L. Coates, et al., J. Franklin Inst., vol. 272, Nov. 1961, p. 366/410.

Linearly separable functions (or threshold functions or majority decision functions) have been defined in earlier reviews. . . . Among the many subjects of interest in threshold logic (necessary conditions for linear separability, optimal realizations, network realizations, estimates of the number of threshold functions, simple majority logic, etc.) the authors concentrate on the problem of determining whether a given switching function is linearly separable and, if so, finding a set of realizing weights and threshold.

ORTHOGONAL FUNCTIONS FOR THE LOGICAL DESIGN OF SWITCHING CIRCUITS
R. P. Coleman, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 379/383.

A new approach to the mathematical representation of switching functions is presented. It was developed in connection with a theoretical study of magnetic-core logic, but the results are considered to be more basic and general than the core-logic problem.

AUTOCORRELATIONS FOR BOOLEAN FUNCTIONS OF NOISELIKE PERIODIC SEQUENCES
B. M. Eisenstadt, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 383/388.

One method of generating a waveform whose correlation function resembles that of noise is by means of combinations of periodic binary sequences. In this paper the properties of the correlation function for arbitrary functions of n periodic binary sequences are investigated.

CASCADED FINITE-STATE MACHINES
A. Gill, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 366/370.

. . . networks of finite-state machines, . . . are discussed. The investigation centers around cascade networks, where the output of one machine serves as an input to another. . . .

ITERATIVE ARRAYS OF LOGICAL CIRCUITS
F. C. Hennie, III, Massachusetts Institute of Technology, Cambridge, Mass., MIT Press, 1961, 242 p.

. . . in the communications sciences. . . especially pertinent to the areas of information processing, switching theory, and computer design. . . . presents a logical development of the properties of the various classes of repeating systems. . . .

BIBLIOGRAPHY ON SWITCHING CIRCUITS AND LOGICAL ALGEBRA
Per A. Holst, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 638/661.

. . . Covers material published through 1958, contains nearly 700 references to articles, books, seminars, and other bibliographies pertaining to the theory of switching circuits and logical algebra.

A COMPUTER PROGRAM FOR THE SYNTHESIS OF COMBINATIONAL SWITCHING CIRCUITS
R. M. Karp, et al., Proc. AIEE 2nd Annual Symp. Switching Circuit Theory, Oct. 1961, p. 182/189.

THE REALIZATION OF SYMMETRIC SWITCHING FUNCTIONS WITH LINEAR-INPUT LOGICAL ELEMENTS
W. H. Kautz, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 371/378.

The problem of synthesizing switching networks out of linear-input (threshold) elements is studied for the class of symmetric switching functions.

TRANSIENT BEHAVIOR IN ITERATIVE COMBINATIONAL SWITCHING
W. K. Kilmer, Proc. AIEE 2nd Annual Symp. Switching Theory, Oct. 1961, p. 114/128.

FUNCTIONAL FORM OF MAJORITY FUNCTIONS AND A NECESSARY AND SUFFICIENT CONDITION FOR THEIR REALIZABILITY
S. Muroga, Proc. AIEE 2nd Symp. Switching Circuits, Oct. 1961, p. 39/46.

"Majority functions" in this paper means "Boolean functions realizable with a single threshold device."

ON THE STATE ASSIGNMENT PROBLEM FOR SEQUENTIAL MACHINES II
R. E. Stearns, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 593/603.

. . . The object of this paper is to find state assignments for the internal states of a sequential machine such that the logical equations representing the machine are relatively simple. This is done by finding assignments for which the computation of a particular state variable depends only on the previous values of a small subset of the variables. . . .

ELEMENTE DER SCHALTUNGSALGEBRA, 2. Aufl.(Elements of Switching Algebra) (In German)
U. Weyh, Munchen, R. Oldenbourg Verlag, 1961, 132 p.

BOOLEAN ALGEBRA AND ITS APPLICATIONS
J. E. Whitesitt, Reading, Mass., Addison-Wesley Publishing Co., Inc., 1961, 182 p.

THE CASCADE DECOMPOSITION OF SEQUENTIAL MACHINES
M. Yoeli, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 587/592.

. . . Studies composite sequential machines obtained from smaller component machines by their connection in cascade, that is, the outputs from one component are the inputs to the next. . . . Given the specification of deterministic, completely specified, synchronous, sequential machine (Mealy model), a criterion is derived for such a specification to be decomposable into specifications of smaller machines, the cascading of which will lead to a realization of the original machine required.

A PROGRAMMED ALGORITHM FOR ASSIGNING INTERNAL CODES TO SEQUENTIAL MACHINES
D. B. Armstrong, IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 466/472.

. . . The method is applicable to both completely and incompletely specified state tables, and permits the use of redundant internal variables if desired. . . . programmed for the 7090 computer.

ON THE EFFICIENT ASSIGNMENT OF INTERNAL CODES TO SEQUENTIAL MACHINES
D. B. Armstrong, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 611/622.

A set of procedures for assigning codes to internal states of a synchronous sequential machine so as to minimize the internal logic in two-level form is proposed.

METHODS OF STATISTICAL SEQUENTIAL ANALYSIS, WITH APPLICATIONS TO RADIO ENGINEERING (In Russian)
A. Y. Basharinov, B. S. Fleyshman, Moscow, Soviet Radio Press, 1962, 353 p.

. . . Examples are given of the application of sequential analysis to problems of extraction of signals from noise, process-control problems, theory of scanning, reliability control, etc. . . .

HEURISTIC REMARKS AND MATHEMATICAL PROBLEMS REGARDING THE THEORY OF CONNECTING SYSTEMS
V. E. Benes, Bell Syst. Tech. J., vol. 41, no. 4, July 1962, p. 1201/1247.

. . . a comprehensive view of the theory of connecting systems, an appraisal of its current status, and some suggestions for further progress.

A SIMPLIFIED PROCEDURE FOR THE REALIZATION OF LINEARLY-SEPARABLE SWITCHING FUNCTIONS
C. L. Coates, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 447/458.

. . . The simplifications arise due to a reduction of the number of functions in the function tree in view of the coefficient ordering.

A NEW APPROACH TO THE DESIGN OF SWITCHING CIRCUITS
H. A. Curtis, New York, D. Van Nostrand, 1962, 557 p.

THE SYNTHESIS OF BOOLEAN FUNCTIONS USING A SINGLE THRESHOLD ELEMENT
I. J. Gabelman, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 639/642.

The synthesis of a threshold element which realizes a desired Boolean function as its output may be accomplished by solving a basic set of linear inequalities. The determination of this basic set is discussed with the aid of a geometric interpretation of such realizable functions on the vertices of a unit N cube.

INTRODUCTION TO THE THEORY OF FINITE-STATE MACHINES
A. Gill, New York, McGraw-Hill Book Co., Inc., 1962, 214 p.

. . . Drwaing heavily on papers by Huffman, Moore, Mealy and many others, the author has written an introductory text considering fundamental analytic aspects of this theory. . . .

EXAMPLES OF ABSTRACT MACHINES
S. Ginsburg, IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 132/135.

Numerous physical situations related to data processing are shown to be modeled by a mathematical entity called a quasi-machine. The situations described include 1) single inputs producing multiple outputs, 2) machines yielding no outputs upon insertion of certain inputs, 3) the retention of the last n outputs only, 4) "erase left" on tape, 5) different input routines doing the same work, and 6) certain types of asynchronous switching circuits.

A STUDY OF ITERATIVE SWITCHING NETWORKS
R. E. Griswold, Stanford Electronics Labs., Stanford U., Calif., Rept. no. SEL-62-008, Technical rept. no. 098-2, 15 Jan. 1962, 114 p., incl. illus., tables, 6 refs., AD 274 349.

. . . formed by the regular interconnection of identical subnetworks. . . . introducing operators that describe iteration. . . . Synthesis procedures, with the minimization of intercell leads as an economy criterion, are developed. . . . A variety of iterative-network forms is possible depending on the geometrical shape of the individual sub-networks.

ALGEBRAIC LOGIC
P. R. Halmos, New York, Chelsea Publishing Co., 1962, 271 p.

. . . results center around statements concerning refutable propositions rather than provable positions.
The entire material of the book has already appeared, in widely dispersed journals, between the years 1954 and 1959.

LOOP-FREE STRUCTURE OF SEQUENTIAL MACHINES
J. Hartmanis, Inform. Control, vol. 4, March 1962, p. 25/43.

. . . extends the author's previous work on the state assignment problem and the decompositio of sequential machines. . . . The investigation is restricted to realization of a sequential machine from several smaller machines which are assumed to be concurrently operating, and the connections between the submachines are assumed to have no loops. It is shown that there are important differences between the Moore and Mealy models when realization of a machine from smaller machines is contemplated, and this discussion is restricted to machines of the Moore type.

STATES OF SEQUENTIAL MACHINES WHOSE LOGICAL ELEMENTS INVOLVE DELAY
F. E. Hohn, Proc. 3rd Annual Symp. Switching Circuit Theory and Logical Design, Oct. 1962, p. 81/90.

ITERATIVE SWITCHING NETWORKS COMPOSED OF COMBINATIONAL CELLS
W. Kilmer, IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 123/131.

The networks considered in this paper consist of n identical combination logic cells connected in cascade through bidirectional discrete information channels. All switching is done synchronously with unit time delay through each cell. Three classes of networks are formed according to whether or not information flow in one direction along the cascade is dependent upon that in the other.

THE SYNTHESIS OF CASCADE SWITCHING CIRCUITS
R. E. Levien, RAND Corp., Santa Monica, Calif., Memo. no. RM-3269-PR, Oct. 1962, 69 p., incl. illus., tables, 15 refs., AD 287 061, N63-19070.

. . . synthesizing switching circuits that compute a given, completely specified switching function, and a new point of view is adopted in which switching circuits are considered to be realizations of algorithms rather than interpretations of truth-functional formulae. . . .

A SURVEY OF SWITCHING CIRCUIT THEORY
E. J. McCluskey, T. C. Bartee, New York, McGraw-Hill Book Co., Inc., 1962.

. . . developed from two sets of lectures by 9 contributors. . . a title such as "Selected Topics in Switching Circuit Theory" would better describe the contents of this book. . .

MINIMUM-STATE SEQUENTIAL CIRCUITS FOR A RESTRICTED CLASS OF INCOMPLETELY SPECIFIED FLOW TABLES
E. J. McCluskey, Jr., Bell Syst. Tech. J., vol. 41, no. 6, Nov. 1962, p. 1759/1768.

. . . Attention is directed to relay-type flow tables in which the only unspecified entries are those which occur because of restrictions on the allowed input-variable changes. For this type of flow table it is shown that a simplified version of the Unger-Paull procedure is sufficient. In particular, only maximum compatibles need be considered in forming the minimum-state sequential circuit.

GENERAL SWITCHING THEORY
R. F. McNaughton, et al., Moore School of Electrical Engineering, U. of Pennsylvania, Philadelphia, Final rept., 31 March 1961-April 1962 on Automatic Computation & Control Techniques, Rept. no. MSR-62-16, ASD TDR 62-599, Oct. 1962, 79 p., incl. illus., refs., AD 290 633.

. . . applicable not only to elementary combinatorial circuits but also to the design of complex sequential switching systems involving many variables, multiple inputs and outputs, memory, computation, and control.

SWITCHING CIRCUITS FOR ENGINEERS
M. P. Marcus, Englewood Cliffs, N. J., Prentice-Hall, Inc., 1962, 290 p.

. . . gives a clear, concise treatment of the design and simplification of combinational and sequential circuits.

GENERALIZED COMBINATIONAL SWITCHING THEORY
T. Robacker, Litton Systems, Inc., Woodland Hills, Calif., Final rept. on Automatic Computation and Control Techniques, Publication no. 2357, Rept. no. BH62-4189-18, Nov. 1962, lv. incl. illus., 4 refs., AD 293 229.

GRUNDLAGEN DER STRUKTURSYNTHESES VON RELAISSCHALTUNGEN (Fundamentals of the Structural Synthesis of Relay Circuits) (In German)
W. N. Roginskij, Munchen, R. Oldenbourg Verlag, 1962, 204 p.

A METHOD FOR SIMPLIFYING BOOLEAN FUNCTIONS
A. H. Scheinman, Bell Syst. Tech. J., vol. 41, no. 4, July 1962, p. 1337/1346.

. . . presents an iterative technique for simplifying Boolean functions. The method enables the user to obtain prime implicants by simple operations on a set of decimal numbers which describe the function. This technique may be used for functions of any number of variables.

STUDIES IN THE THEORY OF SWITCHING CIRCUITS
E. J. Smith, Microwave Research Inst., Rept. no. PIBMRI-1043-62, AFCRL 62-915, 11 July 1962, 46 p., incl. illus., tables, AD 293 860.

. . . Specific results include: an improved Ambit method for realizing cut-set matrices, the detection of partial symmetry in boolean polynomials, realization of symmetric diode circuits, treatment of combinational relay-diode circuits by matrix and graph theoretic methods, and an improvement in an established technique for minimizing the internal states in an incompletely specified sequential machine.

STATE DIAGRAM OF LINEAR SEQUENTIAL MACHINES
C. V. Srinivasan, J. Franklin Inst., vol. 273, May 1962, p. 383/418.

. . . wholly concerned with that special class of synchronous sequential machines whose next-state relations are linear equations in the internal state variables and the input variables, known variously as "linear sequential machines," "linear sequential networks," "modular sequential networks," etc. . . .

INVESTIGATION OF THRESHOLD SWITCHING TECHNIQUES FOR DIGITAL COMPUTERS
Lockheed Aircraft Corp., Sunnyvale, Calif., Final rept., 20 March 1961-31 Jan. 1962, ASD TDR 62-308, June 1962, 274 p., incl. illus., tables, 26 refs., AD 282 275.

Major emphasis is placed on theoretical aspects . . . particular attention given to synthesis methods for specifying networks of threshold devices. . . . Algorithms for partitioning switching functions into sets of threshold functions are described as well as techniques for decomposing networks of unconstrained threshold devices into networks of devices satisfying certain design constraints. . . . Logical design examples are presented to demonstrate the general utility of threshold functions.

SWITCHING CIRCUIT THEORY AND LOGICAL DESIGN
New York, American Institute of Electrical Engineers, 1962, 199 p.

Covers the proceedings of the Third Annual Symposium, held at Chicago in 1962, and sponsored by the AIEE. There are sixteen papers on minimization techniques, sequential circuits and combinational problems all of which will be abstracted and published in this or succeeding issues of Electrical Engineering Abstracts.

ALGEBRAIC PROPERTIES OF SYMMETRIC AND PARTIALLY SYMMETRIC BOOLEAN FUNCTIONS
R. F. Arnold, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 244/251.

INPUT ENCODING IN SEQUENTIAL MACHINES
D. G. Bruckner, Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, 11 Aug. 1963, 61 p., AD 420 592.

Input encoding for synchronous sequential machines. . . changes the binary representations of the inputs to simplify the machine's gating circuitry. Algorithms are developed for input assignment based on the principles of input equivalence and input adjacencies.

SIGNAL FLOW GRAPH TECHNIQUES FOR SEQUENTIAL CIRCUIT STATE DIAGRAMS
J. A. Brzozowski, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 67/76.

. . . characterizing sequential circuits by regular expressions. It is shown that the methods of signal flow graph theory, with the proper interpretation, apply to state diagrams of sequential circuits. The use of these methods leads to a simple algorithm for obtaining a regular expression describing the behavior of a sequential circuit directly from its state diagram.

CLASSIFICATION OF STATE DIAGRAMS
D. B. Chin, Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y., Research rept. PIBMRI1155 63, June 1963, 36 p., AD 412 420.

. . . Topology, Analysis, Sequential analysis. . .

GENERALIZED TREE CIRCUIT—THE BASIC BUILDING BLOCK OF AN EXTENDED DECOMPOSITION THEORY
H. A. Curtis, J. Assoc. Comput. Machinery, vol. 10, Oct. 1963, p. 562/581, A64-11316.

Further improvement of an algorithm developed for the synthesis of switching circuits in forms with tree-like characteristics—generalized tree circuits. . . .

ALGEBRAIC SYNTHESIS OF SWITCHING NETWORKS
R. W. Edwards, Stanford Electronics Lab., Stanford U., Calif., Rept. no. SEL63 029, Technical rept. 2205, April 1963, 73 p., AD 407 486.

. . . synthesis procedure developed in this study has three steps. First, the states of a sequential machine are coded with the elements of a finite field. Second, the transitions of the machine are expressed analytically by a mapping polynomial whose coefficients are in the field. Third, a switching circuit is designed whose organization is simply related to the form of the mapping polynomial. . . .

AN ALGORITHM FOR THE SYNTHESIS OF LARGE SEQUENTIAL SWITCHING CIRCUITS
J. Elsey, Coordinated Science Lab., U. of Illinois, Urbana, Rept. no. R169, May 1963, 49 p., AD 418 163.

INTRODUCTION TO THE THEORY OF FINITE STATE MACHINES
A. Gill, New York, McGraw-Hill Book Co., 218 p.

. . . the author limits his attention to only a relatively small portion of the sequential machine area and his choice of material may not appeal to many of his readers . . .

THE DECOMPOSITION OF FINITE STATE MACHINES
T. V. Griffiths, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 543, Nov. 1963, 101 p., AD 427 880, N64-14663.

A finite state machine is decomposed into the Cartesian product of two smaller finite state machines. . . An addition operation on finite state machines is defined and it is shown that the product operation distributes over the addition operation. . .

A STUDY OF FEEDBACK AND ERRORS IN SEQUENTIAL MACHINES
J. Hartmanis, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 223/232.

The object of this paper is to study feedback in sequential machines, to classify (according to their seriousness) and analyze errors which arise in the state transitions of machines, and to establish some relations between feedback and errors.

ON DYNAMIC SWITCHING IN ONE-DIMENSIONAL ITERATIVE LOGIC NETWORKS
W. L. Kilmer, Montana State Coll. Endowment and Research Foundation, Electronics Research Lab., Bozeman, AFCRL-63-68, March 1963, 30 p., 7 refs., N63-18204.

A FORMAL THEORY OF GENERALIZED MULTIPLE-OUTPUT BINARY COMBINATIONAL SWITCHING NETWORKS
W. L. Kilmer, Electronics Research Lab., Montana State Coll., Bozeman, Final rept., Dec. 1963, 16 p., AD 434 734.

ANALYSIS AND SYNTHESIS OF SEQUENTIAL SWITCHING CIRCUITS
Z. Kohavi, Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y., Research rept. no. PIBMRI-1090-62, June 1963, 88 p., incl. illus., tables, 17 refs., AD 297 066.

. . . simplifying the flow tables of completely specified switching functions. . . assigning the secondary variables to the different states of the circuit. . . secondary assignment for both synchronous sequential machines is given.

SWITCHING NETWORKS BY LINEAR GRAPH THEORY
P. Lavallee, Microwave Research Inst. Polytechnic Inst. of Brooklyn, N. Y., PIBMRI 1146 63, 13 May 1963, 42 p., AD 406 896.

An analytical tool in the realization of circuit matrices is presented. The method is based on forming linear trees with each row of a fundamental circuit matrix and combining them to form a tree of the graph. With this method, more difficult problems in the synthesis of contact networks by linear graph theory can be considered.

IS SWITCHING THEORY MATHEMATICS OR ENGINEERING? (Correspondence)
P. M. Lewis, II, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 320/321.

REALIZATION OF ARBITRARY LOGICAL FUNCTIONS USING MAJORITY ELEMENTS
F. Miyata, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 183/191.

A method is developed for the synthesis of arbitrary combinational logical functions using three-input majority elements. The networks that result are in the form of modified trees. It is shown that an average saving of 30 per cent in majority elements is made on trees of majority elements which individually produce "AND" and "OR" functions.

DETECTION OF TOTAL OR PARTIAL SYMMETRY OF A SWITCHING FUNCTION WITH THE USE OF DECOMPOSITION CHARTS (Correspondence)
A. Mukhopadhyay, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 553/557.

A MODULAR REALIZATION OF SYMMETRIC SEQUENTIAL MACHINES
D. W. Rain, Coordinated Science Lab., U. of Illinois, Urbana, Rept. no. R183, Nov. 1963, 39 p., AD 433 821.

. . . emphasis on the cascade-parallel interconnection of elementary, rather than arbitrarily complex, asynchronous sequential machines. It is shown that additional feedback around a (Huffman model) machine may be used to eliminate certain states of the state diagram. . . .

THE SYNTHESIS OF RELAY SWITCHING CIRCUITS
V. N. Roginskii, New York, D. Van Nostrand, 1963.

GENERAL SYNTHESIS OF TRIBUTARY SWITCHING NETWORKS
J. Sklansky, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 464/469.

A synthesis procedure is described which generates all tributary networks (TRIBs) realizing a given truth function when no a priori assignment of the variables to input terminals is specified. If the truth function is not known to be realizable by a TRIB structure, the synthesis procedure provides a convenient test for TRIB realizability.

BOOLEAN MATRICES AND THE STABILITY OF NEURAL NETS
R. H. Urbano, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 61/66.

The functional states of a neural (combinational) net of prescribed interconnection geometry and over-all net function are characterized and enumerated. The problem is formalized for a class of nets having an arbitrary number of inputs and outputs by introducing the notion of a Boolean matrix. The concept of stability of neural nets (which is closely related to the set of functional states over which the input-output function is invariant) is precisely defined and evaluated for certain general classes of nets.

Related Publications:

FORCING CIRCUITRY: SEQUENTIAL BUILDING BLOCKS FOR LOGICAL DESIGN
R. M. Meade, Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 522/531.

. . . This paper first reviews the current-switching circuits which were developed to solve the problem of integrating storage with logical transformation and of stabilizing data for storage. Radical improvements are then introduced in the form of the forcing circuits, which reduce the delays and cost and increase the logical power of the sequential elements. . . .

SEQUENCE GENERATORS, GRAPHS, AND FORMAL LANGUAGES
Arthur W. Burks, et al., Inform. Control, vol. 5, no. 3, Sept. 1962, p. 204/212.

A sequence generator is a finite graph, more general than, but akin to, the usual state diagram associated with a finite automaton. The nodes of a sequence generator represent complete states, and each node is labeled with an input and an output state. An element of the behavior of a sequence generator is obtained by taking the input and output states along an infinite path of the graph. . . .

THE TREE AS A STRATEGEM FOR AUTOMATIC INFORMATION HANDLING
Walter I. Landauer, Moore School of Electrical Engineering, U. of Pennsylvania, Philadelphia, Final technical rept. no. 2, 15 Dec. 1962, 121 p., incl. illus., tables, 22 refs., AD 293 888.

ANALYSIS OF DELAY IN MATHEMATICAL SWITCHING MODELS FOR DATA SYSTEMS
D. G. Haenschke, Bell Syst. Tech. J., vol. 42, no. 3, May 1963, p. 709/736.

Traffic delay, caused by temporary all-lines-busy conditions, is analyzed for three mathematical switching models. They are classified as "address camp-on", "retrial", and "message storage" models. The models are designed to permit a study of basic traffic theoretical problems encountered in the rapidly growing field of data communications, but they are not identical with any of the existing data switching systems. Each model assumes that a message is switched only through one switching center which must establish connections via line groups to one or more addressed receiving stations, i.e., each model contains only a single switching center. Numerical results for the average delay on all messages are obtained on the IBM 7090 computer.

MARKOV CHAINS: AN INVESTIGATION OF THE DISTRIBUTION OF THE NUMBER OF STEPS TO ABSORPTION IN ABSORBING CHAINS
T. J. Wachowski, Pittsburgh U., Pa., 1963, p. 60, AD 415 138.

Section 3A.13

3A.130: Computer Systems Organization

Included: Single address computers; Triple address computers; Multi-computer data processing systems; On-line computing centers; Standardized building block computer systems; Computer linkage systems; Variable structure computers; Real time operation of computers; Time-shared computational systems; GUS multi-computer system; Multi-program computation methods; Iterative circuit computers; Polymorphic intellectronic system; PILOT multi-computer system; Machine organization; Synchronous computer systems; Autosynchronous computer systems; Knotted list structures: FACT segmentation; Fixed plus variable structure computer; Parallel processing methods.

Cross References: Description of operational computers (3A.020 and 3A.080); Micro-programming methods (3A.150).

Principal Publications:

ON SINGLE VS TRIPLE ADDRESS COMPUTING MACHINES
C. C. Elgot, J. Assoc. Comp. Mach., vol. 1, July 1954, p. 119/123.

The economy of single and triple address machines in coding arithmetical operations is compared. In each case, upper bounds on the number of words necessary to store certain sequences of operations are derived.

ON THE MINIMUM LOGICAL COMPLEXITY REQUIRED FOR A GENERAL PURPOSE COMPUTER
S.P. Frankel, IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 282/285.

A definition is provided for the term "general purpose computer" (gpc) which is compatible with usage and is analogous to, but distinct from, Turing's definition of a "universal computer." A gpc is presented in functional and logical design which seems to approximate the minimum complexity consistent with this definition.

PILOT, THE NBS MULTICOMPUTER SYSTEM
A.L. Leiner, et al., Proc. Eastern Joint Computer Conf., Dec. 1958, p. 71/75.

DESIGN CRITERIA FOR AUTOSYNCHRONOUS CIRCUITS
J.C. Sims, Jr., et al., Proc. Eastern Joint Computer Conf., Dec. 1958, p. 94/99.

The speed limitations of synchronous computers are discussed and design criteria for higher speed operation are presented. Examples for a logic and circuit organization which results in both faster operation and improved performance to cost ratios are given.

REALIZATION OF RANDOMLY TIMED COMPUTER INPUT AND OUTPUT BY MEANS OF AN INTERRUPT FEATURE
L.R. Turner, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 141/149.

THE MULTI-SEQUENCE COMPUTER AS A COMMUNICATIONS TOOL
J.N. Ackley, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 114/119.

. . . more than one sequence or program operates independently, time-sharing the central processing unit . . . becomes a very rapid and economical message switching center by connecting the communications lines as the input and output devices.

PROCESSING DATA IN BITS AND PIECES
F.P. Brooks, Jr., et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 118/124.

A data-handling unit . . . which permits binary or decimal arithmetic to be performed on data fields of any length from one to sixty-four bits. Within the field, character structure can be further specified: these processing entities, called bytes, may be from one to eight bits long. Fields may be stored with or without algebraic sign. On all operations, the relative offset or shift between the operand from memory and that from the accumulator can be specified. The initial application of the variable field length data-processing unit is in the IBM Stretch computer.

A COMPARISON OF MACHINE ORGANIZATIONS BY THEIR PERFORMANCE OF THE ITERATIVE SOLUTION OF LINEAR EQUATIONS
E.J. Gauss, J. Assoc. Comp. Mach., vol. 6, Oct. 1959, p. 476/485.

The performances of four types of machine organizations are compared by their performance in the solution of simultaneous equations by a particular iterative technique. The organizations considered are single address, four address, single address with index registers, and a "complex organization."

A UNIVERSAL COMPUTER CAPABLE OF EXECUTING AN ARBITRARY NUMBER OF SUB-PROGRAMS SIMULTANEOUSLY
J. Holland, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 108/113.

. . . an interesting new computer species introduced by Holland primarily to provide a vehicle for his theoretical study of adaptive systems.

PILOT - A NEW MULTIPLE COMPUTER SYSTEM
A.L. Leiner, et al., J. Assoc. Comp. Mach., vol. 6, July 1959, p. 313/335.

. . . a one-megacycle, vacuum-tube computer system using modified SEAC circuits and small, one-microsecond, diode-capacitor memories. The system comprises three independently programmed computers. . . .

ARITHMETIC AND CONTROL TECHNIQUES IN A MULTIPROGRAM COMPUTER
N. Lourie, et al., Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 75/82.

. . . concerned with two unrelated topics in computer engineering: a time-sharing control system and a form of semiparallel adder. The only relation between these two subjects is that they both form bases of design methods incorporated into the Honeywell 800 System.

ORGANIZING A NETWORK OF COMPUTERS
Datamation, vol. 5, March/April 1959, p. 39.

. . . logical problems which arise when several high-speed electronic computers are connected together to work on a common large-scale task . . .

ORGANIZATION OF COMPUTER SYSTEMS - THE FIXED PLUS VARIABLE STRUCTURE COMPUTER
G. Estrin, Proc. Western Joint Comp. Conf., May 1960, p. 33/40.

. . . a computing system which can be readily reorganized (manually or automatically) into one of a variety of problem-oriented special-purpose systems. More specifically, the subject system would consist of a fixed machine plus an "inventory of substructures."

ITERATIVE CIRCUIT COMPUTERS
J. Holland, Proc. Western Joint Comp. Conf., May 1960, p. 259/265.

. . . an interesting new computer species introduced by Holland primarily to provide a vehicle for his theoretical study of adaptive systems.

THE DETERMINATION OF CARRY PROPAGATION LENGTH FOR BINARY ADDITION
G.W. Reitwiesner, IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 35/38.

. . . In the following argument a formula is derived for the determination of the expected maximum length of zero or nonzero carry propagation in the addition of two binary number of n digits each.

COMMUNICATIONS WITHIN A POLYMORPHIC INTELLECTRONIC SYSTEM
G.P. West, et al., Proc. Western Joint Comp. Conf., May 1960, p. 225/227.

. . . expository paper is concerned with the RW-400 system, which is made up of a highly flexible interconnected network of individual general-purpose computer modules, auxiliary storage devices (buffer modules), and input-output modules. . . .

A NEWTYPE OF COMPUTER FOR PROBLEMS IN PROPOSITIONAL LOGIC, WITH GREATLY REDUCED SCANNING PROCEDURES
C. Cherry, et al., Inform. Control, vol. 4, no. 2/3, Sept. 1961, p. 155/168.

A simple scanning-type binary logical computer starts by assigning the truth-value 0 to all the variables (propositions) and systematically executes a binary count until the truth value 1 is assigned to all variables. With n variables a scan of 2^n steps is then needed. At each step, all the logical constraints usually are tested simultaneously and only when all are satisfied is a solution to the problem obtained. . . .

A NOTE ON THE SYSTEM REQUIREMENTS OF A DIGITAL COMPUTER FOR THE MANIPULATION OF LIST STRUCTURES
H. Gelernter, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 484/489.

. . . system requirements of a digital computer for which the use of list techniques is to be competitive with standard programming, so that the particular memory organization for a given problem may be chosen on the basis of suitability and ease of programming alone. . . .

SABER: A REAL-TIME PROBLEM IN TELEPROCESSING
K.S. Hope, Computer J., vol. 4, July 1961, p. 109/113.

. . . for booking airline flights . . . consists of input-out consoles installed at the ticket window, connected by telephone or teletype lines to a data processing center. At the center a "7000" series IBM computer handles the SABER program. The system is expected to go into operation by March of 1962.

SOLUTION OF NONLINEAR INTEGRAL EQUATIONS USING ON-LINE COMPUTER CONTROL
G. J. Culler, et al., Proc. A FIPS Spring Joint Computer Conf., May 1962, p. 129/138.

. . . paper deals with the application of the on-line computation techniques to the solution of a certain nonlinear integral equation which occurs in the Bardeen-Cooper-Schrieffer theory of superconductivity.

CONTROL UNITS FOR SEQUENCING COMPLEX ASYNCHRONOUS OPERATIONS
A. Grasselli, IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 483/493.

Sequential circuits techniques for the synthesis of digital-computer-control units are investigated. The assumption is made that the operations to be controlled are complex sequences of asynchronous events linked by precedence relations. An algorithm for the synthesis of the control unit flow table from the list of precedence statements is given.

FACT SEGMENTATION
M.N. Greenfield, Proc. A FIPS Spring Joint Computer Conf., May 1962, p. 307/315.

. . . the problem of large programs which do not fit entirely in core memory, but which can be divided into segments which are loaded only when needed during program execution. In this system, which was implemented on the Honeywell 800, the programmer segments his program and indicates, in the code, points where segments are no longer needed.

ADAPTIVE MECHANISMS IN DIGITAL CONCEPT PROCESSING
M. Kochen, Proc. Joint. Automatic Control Conf., Session 17-4, no. 1-9, June 1962.

. . . Describes a "hypothetical machine" for information retrieval. This machine would supposedly go beyond the usual features of a storage device and do additional operations of data organization and inference. Given these additional operations, the machine often would be able to answer questions from material information not explicitly stated by the input data.

A COMPUTER FOR SOLVING LINEAR SIMULTANEOUS EQUATIONS USING THE RESIDUE NUMBER SYSTEM
R.M. Guffin, IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 164/173.

. . . The computer has been arbitrarily designed to solve dense systems of equations with as many as 128 unknowns and sparse systems and as many as 512 unknowns. Operating at 500-kc clock rate, the computer would be able to perform one complete iteration on a system with 128 unknowns 30 times faster than an IBM 704.

AN ANALOG-DIGITAL REAL TIME COMPUTER
T.D. Truitt, IRE Trans. Electronic, Comp., vol. EC-11, no. 1, Feb. 1962, p. 46/52.

Planned as the central calculator in a "faster-than-real-time" computing system for a space range . . . employs many, high-speed, digital circuits in parallel to calculate the solutions to sets of nonlinear differential equations.

KNOTTED LIST STRUCTURES
J. Weizenbaum, Commun. ACM, vol. 5, March 1962, p. 161/165.

A machine organization facilitating the implementation of List processes is outlined. The random access memory of the machine is divided into two parts, available space and a regularly addressable part called regional memory.

REAL-TIME COMPUTATION AND RECURSIVE FUNCTIONS NOT REAL-TIME COMPUTABLE
H. Yamada, IRE Trans. Electronic Comp., vol. EC-11, no. 6, Dec. 1962, p. 753/760.

As an attempt to investigate a general theory of real-time computability in digital computers, a subclass of Turing machines is formally introduced together with some classes of functions that are computable by them in real time. Then the existence is established of a class of recursive functions that are not computable in real time by use of a class of machines, no matter how general we make the machines subject to a given constraint.

THE NEXT GENERATION OF COMPUTERS
Control Engrg., vol. 9, Feb. 1962, p. 22/25.

. . . New types of machine organization are expected to allow simultaneous operation. Emphasis will be placed on pure parallel operation and the planning of information flow will be radically altered. One type of computer already in use employs two information channels instead of an arithmetic unit. One channel carries information in, the other out; input and output units, control and arithmetic units and memory units, are arranged in parallel between these channels.

SOME ASPECTS OF THE LOGICAL DESIGN OF A CONTROL COMPUTER: A CASE STUDY
R. L. Alonso, et al., IRE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 637/697.

Some logical aspects of a digital computer for a space vehicle are described, and the evolution of its logical design is traced. . . . the Apollo Guidance Computer (AGC) . . . is an onboard computer for one of the forthcoming manned space projects, a fact which is relevant primarily because it puts a high premium on economy and modularity of equipment, and results in much specialized input and output circuitry. The computer is a parallel, single address machine with more than 10,000 words of 16 bits. Such a short word length yields advantages of efficient storage and speed, but at a cost of logical complexity in connection with addressing, instruction selection, and multiple-precision arithmetic.

AN ON-LINE COMPUTING CENTER
G. J. Culler, et al., Thompson Ramo Wooldridge, Inc., Canoga Park, Calif., 11 Feb. 1962 - 11 Feb. 1963., RADC TDR63 160, July 1963, p. 118, AD 414 564, N63-20018.

. . . allows direct use of a high speed digital computer by mathematicians and scientists in their specialized fields. This report describes the system in detail from a user's point of view. For reference purposes, the report includes a listing of all computer programs used in the system.

PARALLEL PROCESSING IN A RESTRUCTURABLE COMPUTER SYSTEM
G. Estrin, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 747/755.

. . . problem-oriented configurations of the variable structure computer. . . . is achieved by programmed or physical restructuring of a part of the hardware. Existence of important classes of problems which the variable structure computer system promises to render practically computable, as well as use of the system for experiments in computer organization and for evaluation of new circuits and devices warrant construction of a variable structure computer. This paper describes the organization, programming, and hardware of a variable structure computer system presently under construction at UCLA.

AUTOMATIC ASSIGNMENT OF COMPUTATIONS IN A VARIABLE STRUCTURE COMPUTER SYSTEM
G. Estrin, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 755/773.

The problem of optimal assignment of subcomputations of a computational task to autonomous computing structures of a variable structure computing system is investigated. In particular, it is desired to determine which computing structures should be constructed from the hardware inventory of the variable structure computing system and which subcomputations should be executed on which computing structures, and in what sequence, so as to minimize the total cost of computation . . .

A MULTILAYER ITERATIVE CIRCUIT COMPUTER
R. Gonzalez, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 781/790.

. . .(I. C. C.) is . . . capable of dealing with problems involving spatial relationships between the variables, in addition to the inherent multiprogramming capabilities of this type of machine organization. . . . 1) A path-building method . . . 2) A specialization in the functions of the individual layers . . . 3) Three-phase operation . . .

THE EURATOM COMPUTER LINKAGE SYSTEM
C. Green, Italy Sci. Data Processing Center, 1963, 11 p., (EUR-284, e; CETIS Rept. 40), Available from Belgian American Bank and Trust Co., N. Y., account No. 121.86; N63-19915.

This report describes a project for the construction of a system for the linkage of digital and analog computers. It proposes two principles hitherto unused in this field, namely an asynchronous system for the regulation of the passage of data from the analog computer to the A-D converters, and an interpolation system at the output of the digital computer. . . .

A PARALLEL COMPUTER ORGANIZATION AND MECHANIZATIONS
J. K. Hawkins, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 251/262.

. . . organization is dominated by two characteristics, namely, one-bit storage per computational cell and single-level logic at each computational step. The organization is directed specifically toward spatial problems, but is demonstrated to be of a general-purpose nature. . . .

MULTI-COMPUTER DATA PROCESSING SYSTEM FOR A NAVY COMMAND AND CONTROL CENTER
A. Hughes, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 262/264.

TIME SHARING ON THE FERRANTI-PACKARD FP6000 COMPUTER SYSTEM
M. J. Marcotty, et al., Proc. Spring Joint Computer Conf., vol. 23, May 1963, p. 29/40.

. . . described for a medium-sized, high-speed digital computer. A combination of hardware and software is used to accomplish the task. . . .

THE GUS MULTICOMPUTER SYSTEM
W. F. Miller, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 671/676.

. . . The GUS computer . . . is currently being used to explore the problems of multi-computer systems. . . . two principal computation units GEORGE and FLIP. . . . FLIP, the faster of the two, is a high-speed solid-state machine which has been designed to serve as the principal arithmetic unit of the system. . . . GEORGE, the slower machine, has been delegated most of the nonarithmetic functions.

GROUP COMMUNICATIONS AND PROGRAM INTERACTION IN TIME-SHARING SYSTEMS
A. M. Rosenberg, System Development Corp., Santa Monica, Calif., Rept. no. SP 1386, 14 Oct. 1963, 29 p., AD 430 264.

. . . direct and indirect communications between individual users and time-sharing systems object programs . . . applications being investigated in the ARPA-SDC time-sharing system that involve variations on group communication with a computer system and indicates operational design considerations necessary to implement such general communication capabilities in a time-sharing system.

SYSTEM DESIGN OF A SMALL, FAST DIGITAL COMPUTER
H. Schorr, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 698/706.

. . . a 250 Mc tunnel-diode computer . . . a sophisticated advanced control is used. . . . These instructions and operands are stored in two small, high-speed tunnel-diode memories which are called queues. A third queue, the Storage Access Queue, is used for saving a storage access request if it cannot be serviced immediately.

STANDARDIZED BUILDING BLOCK COMPUTER SYSTEM
B. L. Simpson, Librascope Div., General Precision Inc., Glendale, Calif. Final engineering rept., developmental phase, May 1957 - Jan. 1962, (ASD TDR 62-566), 22 Jan. 1962, 381 p. AD 299 712.

THE COMPUTER SYSTEM ISSUE
D. L. Slotnick, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 607/608.

Two main paths have thus far emerged: parallel systems and special purpose systems. . . . The first six papers represent a cross section of recent general purpose systems developed outside the United States. . . Aerospace Systems. New System Organization. Pattern Recognition Systems. Advanced Techniques.

ON LINE DIGITAL COMPUTATION OF THE VARIANCE OF A TIME SERIES
R. S. Smith, Illinois U., Urbana, 20 March 1963, 6 p., AD 406 791.

Statistical variance has been widely used in propagation studies associated with radio direction finding for many years. With . . . high speed digital computing machinery it is advisable to explore . . . on-line computations . . .

SOME IMPLICATIONS OF REAL-TIME, TIME-SHARED COMPUTATIONS
H. M. Teager, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 793.

THE D 825 AUTOMATIC OPERATING AND SCHEDULING PROGRAM
R. N. Thompson, et al., Proc. Spring Joint Computer Conf., vol. 23, May 1963, p. 41/49.

. . . desire to eliminate idle computing capacity during input/output (I/O) data transfer has led to "simultaneous" read-write-compute hardware in which the I/O function is decoupled from the arithmetic/control function as they time share the main memory. . . . multiprogramming, or the time sharing of memory, arithmetic/control and I/O among several operating programs, has received attention.

ASSIGNMENT OF INVENTORY OF A VARIABLE STRUCTURE COMPUTER
R. Turn, California U., Los Angeles, Rept. no. 63-5, Jan. 1963, 499 p., AD 298 203.

A MACHINE ORGANIZATION FOR A GENERAL PURPOSE LIST PROCESSOR
R. L. Wigington, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 707/714.

A general purpose list processor organized machine is postulated that: 1) carries out directly the basic processes involved in list processing, 2) includes arithmetic and other features needed for a general purpose machine and 3) adapts to operation in a wide variety of programming languages.

The power of the machine is achieved by using a small fast scratch pad memory for manipulating address fields and by including an automatic symbol table in the form of a search memory.

Related Publications:

A DUAL MASTER FILE SYSTEM FOR A TAPE PROCESSING COMPUTER
S. Blumenthal, J. Assoc. Computing Mach., vol. 5, Oct. 1958, p. 319/327.

. . . In this prototype system, part of the information in the file is ordered on tape and is not amenable to retrieval at random. The balance of the information is available in a low-cost-per-item random-access arrangement such as a punched-card tub file.

A REAL TIME DATA ASSIMILATOR
H. W. Gachwind, Commun. Assoc. Comp. Mach., vol. 2, July 1959, p. 33/36.

. . . input is read directly into ancillary storage registers, by-passing conventional buffers . . . These special registers, called loading platforms, like normal memory registers may be referred to by arithmetic and logic instructions and differ only in that interlocks prevent their being written on. Output is treated analogously. The system provided for real-time manipulation of data from many sources.

ONE-LEVEL STORAGE SYSTEM
T. Kilburn, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 223/235.

. . . an automatic system which in principle can be applied to any combination of two storage systems so that the combination can be regarded by the machine user as a single level. . . . scheme incorporates a "learning" program, a technique which can be of greater importance in future computers.

RETRIEVAL OF ORDERED LISTS FROM A CONTENT-ADDRESSED MEMORY
M. H. Lewin, RCA Rev., vol. 23, no. 2, June 1962, p. 215/229.

. . . A new "column-pair" sensing arrangements is proposed which results in an interrogation routine that retrieves an m-word list in exactly 2m — 1 accesses or read cycles . . .

THE IMPLEMENTATION OF A MODULAR ARITHMETIC COMPUTER WITH BINARY LOGIC ELEMENTS
R. L. Beadles, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 161/164.

. . . This study has for the most part been concerned with developing suitable algorithms for performing the fundamental arithmetic and logical operations on residue-coded numbers. The potential advantages of a digital computer employing modular arithmetic derive from the fact that both addition and multiplication of modular coded numbers are each carry-free, one step operations. . . .

A GROUP INTERACTION EXPERIMENT
M. M. Flood, System Development Corp., Santa Monica, Calif., Rept. no. TM1512, 1 Oct. 1963, 34 p., AD 428 494.

. . . Discusses stochastic learning models adequate for parameter estimation and goodness-of-fit testing purposes . . . the objective of these experiments is to develop a valid formal theory of interactive behavior that might eventually provide the basis for much more effective design and management of units having command and control functions.

VARIABLE FIELD-LENGTH DATA MANIPULATION IN A FIXED WORD-LENGTH MEMORY
M. J. Flynn, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 512/516.

. . . several representative memory-access systems that avoid the housekeeping necessary for processing variable-length operands in a fixed word-length machine and to evaluate their relative efficiencies.

A MEMORY ORGANIZATION FOR AN ELEMENTARY LIST-PROCESSING COMPUTER
V. O. Muth, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 262/265.

. . . presents an elementary computer memory organization capable of direct representation and manipulation of simple linear lists. A conventional random-access memory is used in conjunction with a group of address and word-length registers to store and manipulate single-link list words. . . .

Section 3A.14

3A.140: Computer Languages, Subroutines and Compilers

Included: Micro-programming methods; Automatic programming methods; ADAM = Advanced data management system; List processing computer languages; COMIT; CORC; Special algorithms; ALGOL; INTRIGUE subroutine; MOIST; FORTRAN; Theory of algorithms; Macro-programming systems; BOUMAC; JOVIAL; MOBILE; COBOL; Context-free languages; LISP; Translators for computer languages; FORAST; Computer codes; NELIAC; FAST translator; SIMSCRIPT; APEX compiler; MONEY; String languages.

Cross References: Programming of computers (3A.150).

Principal Publications:

LOGICALLY MICRO-PROGRAMMED COMPUTERS
J. V. Blankenbaker, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 103/109.

. . . class of computers can duplicate the behavior of any finite state digital computer except in solution time. Also, design techniques are given for computers employing only multiple-bit time delays.

MICRO-PROGRAMMING
M. V. Wilkes, Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 18/20.

The design of digital-computer sequencing units in which storage for the micro-program is provided by means other than the wiring of the control unit is discussed.

THE DESIGN OF A GENERAL-PURPOSE MICROPROGRAM-CONTROLLED COMPUTER WITH ELEMENTARY STRUCTURE
T. W. Kampe, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 208/213.

This paper presents the design of a parallel digital computer utilizing a 20 μsec core memory and a diode storage microprogram unit. The machine is intended as an on-line controller and is organized for ease of maintenance. . . .

NOTE ON THE BOOLEAN PROPERTIES OF CONTEXT FREE LANGUAGES
S. Scheinberg, Inform. Control, vol. 3, no. 4, Dec. 1960, p. 372/375.

. . . One often considers the family of languages which have grammars meeting certain specifications . . . A major question of interest is whether such a family is a closed system with respect to the Boolean operations . . . answer this question for another family of languages, called "type 2" or "context free" by Chomsky (1959). . . . a context free grammar is essentially a special case of a semi-Thur system . . .

THE USE OF THE COMPLEX ALGORITHM IN THE MECHANIZATION OF BOOLEAN SWITCHING FUNCTIONS BY MEANS OF MAGNETIC CORES
S. N. Einhorn, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 615/622.

COMPUTER LANGUAGES FOR SYMBOL MANIPULATION
B. F. Green, Jr., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 729/735.

. . . Reprinted from a special issue on Automation of Human Functions, published by IRE Transactions On Human Factors in Electronics.

AN ALGORITHM FOR PATH CONNECTIONS AND ITS APPLICATIONS
C. Y. Lee, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 346/365.

IMPLEMENTATION OF JOVIAL IN SSRL
M. H. Perstein, System Development Corp., Santa Monica, Calif., Rept. no. TM555 200 00, 18 Dec. 1961, 37 p., AD 430 346.

USE OF A LIST PROCESSING LANGUAGE IN PROGRAMMING SIMPLIFICATION PROCEDURES
S. R. Petrick, Proc. of AIEE 2nd Annual Symp. Switching Circuit Theory, Oct. 1961, p. 18/24.

The classical problem in switching theory of obtaining a minimum two-stage diode circuit realization of a Boolean function is considered. The problem has been programmed in the MIT LISP I system. . . . the program is only slightly dependent on the characteristics of a particular machine.

AN ALGORITHM FOR RAPID BINARY DIVISION
J. B. Wilson, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 662/670.

ANNUAL REVIEW IN AUTOMATIC PROGRAMMING (VOL. I)
R. Goodman (editor), New York, Pergamon Press, Ltd., 300 p.

A PROGRAMMED ALGORITHM FOR ASSIGNING INTERNAL CODES TO SEQUENTIAL MACHINES
D. B. Armstrong, IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 466/472.

A relatively fast procedure for assigning codes to the internal states of a sequential machine is described . . . applicable to both completely and incompletely specified state tables, and permits the use of redundant internal variables if desired. . . .

LANGUAGE PROBLEMS POSED BY HEAVILY STRUCTURED DATA
R. F. Barnes, Commun. ACM., vol. 5, Jan. 1962, p. 28/34.

The direct representation of natural language material in a graph-theoretic form as an aid to information retrieval is discussed. Examples of how the layered structure of the information in a document may be brought to light by a graph-theoretic language are given with particular reference to chemical information retrieval.

THE FORAST PROGRAMMING LANGUAGE FOR ORDVAC AND BRLESC
L. W. Campbell, et al., Aberdeen Proving Ground, Ballistic Research Labs, Md., BRL-1172, Aug. 1962, 125 p., 3 refs., N63-17884.

LOGARITHMIC AND EXPONENTIAL FUNCTION EVALUATION IN A VARIABLE STRUCTURE DIGITAL COMPUTER
D. Cantor, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 155/164.

TRANSLATION OF RETRIEVAL REQUESTS IN A "SEMIFORMAL" ENGLISH-LIKE LANGUAGE
T. E. Cheatham, Jr., et al., Commun. ACM., vol. 5, Jan. 1962, p. 34/39.

PHILCO 2000 JOVIAL SUBROUTINE LIBRARY
E. Clark, System Development Corp., Santa Monica, Calif., Rept. no. TM555 202 00, 19 April 1962, 2 p., AD 430 262.

PHASE I OF THE PHILCO 2000 JOVIAL TRANSLATOR
E. Clark, System Development Corp., Santa Monica, Calif., Rept. no. TM555 211 00, 3 Aug. 1962, 60 p., AD 430 246.

AN EVALUATION OF AUTOCODE READABILITY
P. V. Ellis, Commun. ACM., vol. 5, March 1962, p. 156/159.

Rapidwrite, a subset of COBOL, is described. . . .

THE DESIGN OF PROGRAM-MODIFIABLE MICRO-PROGRAMMED CONTROL UNITS
A. Grasselli, IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 336/339.

PHILCO 2000 JOVIAL STRING ROUTINES
E. Hayes, System Development Corp., Santa Monica, Calif., Rept. no. TM555 201 00, 17 April 1962, 7 p., AD 430 263.

ABS12 ALGOL: AN EXTENSION TO ALGOL 60 FOR INDUSTRIAL USE
R. W. Hockney, Computer J., vol. 4, Jan. 1962, p. 292/300.

IMPLEMENTATION OF LOGIC
R. W. House, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 297/302.

. . . the development of computer programs for automatic checkout and the simplification of switching networks, certain simple logical routines occur frequently. Only a few such routines are needed to cover a large number of situations. . . .

AUTOMATIC-PROGRAMMING-LANGUAGE TRANSLATION THROUGH SYNTACTICAL ANALYSIS
R. S. Ledley, et al., Commun. ACM., vol. 5, March 1962, p. 145/155.

A tutorial exposition of a syntax-directed automatic-programming-language translation with examples from aspects of ALGOL . . .

LISP 1.5 PROGRAMMER'S MANUAL
J. McCarthy, et al., Research Lab. of Electronics, Mass. Inst. of Tech., Cambridge, 17 Aug. 1962, 99 p., AD 419 477.

. . . LISP is a formal mathematical language. . . . possible to give a concise yet complete description of it. . . .

AN INTRODUCTION TO ALGOL
H. R. Schwarz, Commun. ACM., vol. 5, Feb. 1962, p. 82/95.

A STRING LANGUAGE FOR SYMBOL MANIPULATION
J. H. Wegstein, et al., Commun. ACM., vol. 5, Jan. 1962, p. 54/61.

COMIT AS AN IR LANGUAGE
V. H. Yngve, Commun. ACM., vol. 5, Jan. Jan. 1962, p. 19/28.

FAST - FORTRAN AUTOMATIC SYMBOL TRANSLATOR
MITRE Corp., Bedford, Mass., Rept. no. SR24, ESD TDR63 395, Jan. 1962, lv., AD 409 171.

. . . a problem-oriented language and coding system for the IBM 704, 709, or 7090 computers. . . . extensive use at MITRE for more than a year . . .

REFERENCES MANUAL FOR EASY. AN AUTOMATIC PROGRAMMING SYSTEM FOR THE ALWAC COMPUTER
K. Appel, Uppsala U. (Sweden), Scientific rept. no. 3; Preprint no. 108, AD 432 389.

MOIST MACRO OUTPUT INPUT SYSTEM FOR THE IBM 7090
G. M. Berns, Maryland U., College Park, Computer Science Center, Jan. 1964, 48 p., N64-16753.

. . . designed to make the tasks of reading reading input and writing output as easy to program as simple addition and subtraction. The advantage and capabilities of the system are described, along with numerous examples illustrating its use.

JTS USER'S MANUAL
M. Bleier, et al., Systems Development Corp., Santa Monica, Calif., Rept. no. TM1577 000 00, 12 Dec. 1963, 71 p., AD 428 974.

A COMPARISON OF LIST-PROCESSING COMPUTER LANGUAGES
D. G. Bobrow, et al., RAND Corp., Santa Monica, Calif., Memo. RM3842PR, Oct. 1963, 37 p., AD 422 258.

A detailed comparison is presented of COMIT, IPL-V, LISP 1.5, and SLIP-four well-known computer programming languages which, among them, exhibit all the principal characteristics of existing list-processing languages. . . .

OPERATING INSTRUCTIONS AND OUTPUTS OF THE J-X.2 ONE PASS COMPILER AND LOADER
E. Book, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM 970 003 01A, 18 Nov. 1963, 7 p., AD 427 679.

THE OAK RIDGE ALGOL COMPILER FOR THE CONTROL DATA CORPORATION 1604 - PRELIMINARY PROGRAMMER'S MANUAL
L. L. Bumgarner, Oak Ridge National Lab., Tenn., Mathematics. Div., ORNL-3460, 30 Jan. 1964, 48 p., refs., N64-15338.

A knowledge of Algol 60 is assumed. Included are descriptions of input-output facilities and details for operation under the monitor system.

ADAM, AN EXPERIMENTAL DESIGN TOOL
J. H. Burrows, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 389/390.

The ADAM (Advanced Data Management) System, a facility the ESD/MITRE System Design Laboratory, is a computer program developed for experimentation with command information systems. ADAM will allow exploration and verification of new concepts of on-line information processing. With ADAM, alternative designs for the man-machine interaction aspects of command information systems can be tested without reprogramming an experimental system. . . .

IMPLEMENTATION OF JOVIAL IN SSRL
E. Clark, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM555 200 00A, 23 March 1963, 15 p., AD 430 245.

CORC - THE CORNEL COMPUTING LANGUAGE
R. W. Conway, et al., ACM, Communications, vol. 6, June 1963, p. 317/321, A63-21160.

BOUMAC, A MACRO-PROGRAMMING SYSTEM FOR SCIENTIFIC COMPUTATION
J. H. Devenney, et al., National Bureau of Standards, Boulder, Colo., NBS-TN-203, 18 Dec. 1963, 42 p., refs., N64-13939.

. . . needs only to know the various mathematical operations which are required to obtain the information he wants from the data and to learn to use a simple code with which to specify these mathematical operations.

APPLICATION OF OPERATIONS RESEARCH TO INTERFERENCE, PHASE II
B. Ebstein, et al., IIT Research Inst., Chicago, Ill. Technology Center, ITT-RI-5177-FR; RADC-TDR-63-387, 1963, 196 p., 24 refs., N63-23131.

. . . Four different optimization algorithms are presented in the form of computer programs written in ALGOL 60 . . .

AN ALGORITHM FOR GENERATING PSEUDO-RANDOM PERMUTATIONS
R. Eisen, Northwestern Technological Inst., Evanston, Ill., Research memo. 93, Feb. 1964, 5 p., AD 431 536, N64-16864.

INTRIGUE, AN IBM-7090 SUBROUTINE PACKAGE FOR MAKING LINEAR, LOGARITHMIC AND SEMILOGARITHMIC GRAPHS USING THE CALCOMP PLOTTER
M. B. Emmett, Oak Ridge National Lab, Tenn., Neutron Physics Div., ORNL-3581, March 1964, 16 p., refs., N64-17717.

A STUDY OF IBM 7094 FORTRAN IV SUBROUTINES
D. Epstein, Sperry Gyroscope Co., Great Neck, N. Y., In its Minimum Variance Orbit Determination Program, 8 Nov. 1963, p. 65/71, N64-18231.

. . . results of an investigation to determine the accuracy of the single-and double-precision numerical subroutines that are standard for the IBM 7094 version of FORTRAN IV . . . to find the rms error and maximum error for error analysis purposes . . .

ADD STORAGE FORTRAN FOR THE IBM 7074/2/4
D. R. Fitzwater, et al., Iowa State U. of Science and Tech., Ames Lab., IS-721, Sept. 1963, 28 p., refs., N64-10221.

A BRIEF REVIEW OF SIMSCRIPT AS A SIMULATING TECHNIQUE
M. A. Geisler, et al., RAND Corp., Santa Monica, Calif., Memo. RM3778PR, Aug. 1963, 21 p., AD 411 324.

. . . a way of designing and writing down a simulation model . . . The method is not only an abridged language, but also a structure with the help of which a wide class of management problems can be programmed to a computer. . . . streamlines programming . . .

MICROPROGRAMMED CONTROL FOR COMPUTING SYSTEMS
C. B. Gerace, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 733/747.

. . . A general scheme is discussed to improve flexibility and reduce the number of micro-orders through massive use of the conditions for the next micro-order. A variable-cycle timing system that permits the speed of a synchronized computer to approach that of an asynchronous one is presented. . . .

AUTOMATIC PROGRAMMING TECHNIQUES (PHASE I)
P. Gilbert, et al., Teledyne Systems Corp., Hawthorne, Calif., Final rept., RADC TDR63 563, Feb. 1964, 191 p., AD 434 760.

QUOTIENTS OF CONTEXT-FREE LANGUAGES
S. Ginsburg, et al., J. Assoc. Comput. Machinery, vol. 10, Oct. 1963, p. 487/492, 12 refs., A64-11313.

A SURVEY OF ALOGOL-LIKE AND CONTEXT FREE LANGUAGE THEORY
S. Ginsburg, System Development Corp., Santa Monica, Calif., Rept. no. TM738 006 00 and SR8,.AFCRL 64 283, 6 March 1964, 22 p., AD 437 325.

A BOUND ESCALATION METHOD FOR THE SOLUTION OF INTEGER LINEAR PROBLEMS
F. Glover, Graduate School of Industrial Administration, Carnegie Inst. of Tech., Pittsburgh, Pa., Rept. no. ONR RM119, Dec. 1963, 58 p., AD 436 454.

An algorithm for solving integer programming problems is presented which transforms an integer matrix into a new integer matrix exhibiting a special substructure called the bounding form. . . .

TEST PROCEDURE LANGUAGE DEVELOPMENT
G. P. Gollomp, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1327/1334.

. . . this paper will be devoted to the discussion of test language development, compiler design, and influence on test system organization. . . .

SCF COMPUTER PROGRAM SYSTEMS MANUAL LOGARITHM SUBROUTINE (LOG)
E. L. Griffith, System Development Corp., Santa Monica, Calif., Rept. no. TM705 053 00, 22 Nov. 1963, 3 p., AD 425 708.

TECHNICAL APPENDIX ON THE SIMSCRIPT SIMULATION PROGRAMMING LANGUAGE
B. Hausner, et al., RAND Corp., Santa Monica, Calif., Memo. RM3813PR, Aug. 1963, 15 p., AD 415 797.

. . . of value in advanced applications of SIMSCRIPT . . . has been used in the simulation of a wide variety of systems including logistics, manufacturing and computer operations.

A SYNTAX-ORIENTED COMPILER FOR LANGUAGES WHOSE SYNTAX IS EXPRESSIBLE IN BACKUS NORMAL FORM AND SOME PROPOSED EXTENSIONS THERETO
P. Z. Ingerman, Moore School of Electrical Engineering, U. of Pennsylvania, May 1963, lv., AD 417 350.

. . . applicable to an iterated compilation process, where each phase of the compilation generates the rules of syntax required for the next phase of the compilation. Complete flow charts . . . are essentially machine-independent. . . .

MOBILE, A MORBIDIC COBOL COMPILER
E. W. Jervis, Jr., Sylvania Electronic Systems, Needham, Mass., Final rept., 25 Feb. 1962-27 Dec. 1963, Rept. no. FR64 1N, 27 Dec. 1963, lv., AD 428 180.

. . . auxiliary programs that were used during the compiler development are included. . . .

NELIAC-N: A TUTORIAL REPORT
J. W. Kallander, et al., Naval Research Lab., Washington, D. C., NRL 5976; 17 June 1963, 140 p., AD 408 965.

. . . minimizes the knowledge of the actual computer required by the programmer, maximizes the readability of the programs themselves, . . . provides carry-over value of program from one computer to another.

USE OF AUTOMATIC DEVICES IN CONTROL UNITS OF DIGITAL COMPUTERS

V. I. Kartashov, Joint Publications Research Service, Washington, D. C., JPRS-23816, OTS-64-21867, 23 March 1964, 10 p., refs., Transl. into English from Avtomatyka (Kiev), v. 8, no. 6, 1963, p. 11/16, N64-17349.

A method is discussed for combining the desired microprogarms of operations, which have identical sequences of microoperations in any parts of the microprograms, for the purpose of finding a single automatic device for carrying out all microoperations. This method deals with the building of a cycle-formation automatic device.

ADVANCED MYSTIC: A COMPILER FOR MANAGEMENT CONTROL OF COMPUTER PROGRAMMING

R. G. Kelly, American Institute of Aeronautics and Astronautics, Space Flight Testing Conference, Cocoa Beach, Fla., Paper 63102, March 18-20, 1963, A63-16677.

. . . adapted to the IBM 7090. . . . designed for applications requiring great input/output versatility, high compiling and operating speed and large storage capacity. . . . uses a functional macro-operator structure . . . adaptable to . . . data reduction, commercial data processing, and analog computer simulation.

APEX-III: AN ALGEBRAIC COMPILER FOR THE G-20 COMPUTER

J. M. Kennedy, et al., Atomic Energy of Canada, Ltd., AECL 1728, April 1963, 54 p., AD405 945.

COMPILING AND INTERPRETING SYSTEMS FOR USE OF STANDARD PROGRAMS FOR THE BESM COMPUTER OF THE ACADEMY OF SCIENCES USSR COMPUTER CENTER

V. M. Kurochkin, Foreign Tech. Div., Air Force Systems Command, Wright Patterson AFB, Ohio, 9 May 1963, 52 p., AD 414 768.

ROUTING FOR FINDING ROOTS OF POLYNOMIALS WITH REAL COEFFICIENTS

T. Leser, Aberdeen Proving Ground, Ballistic Research Labs., Md. BRL-MEMO-1467, April 1963, 17 p., N63-17232, AD 406 436.

FNOL2, A FORTRAN (IBM 7090) SUBROUTINE FOR THE SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS WITH AUTOMATIC ADJUSTMENT OF THE INTERVAL OF INTEGRATION

J. S. Linnekin, et al., Naval Ordnance Lab., White Oak, Md., NOLTR 63-171, Math Dept. Rept. M-38, N63-23610.

. . . up to 30 ordinary differential equations. It uses double precision arithmetic in key locations . . . has the option of automatically varying the interval of integration, h, to hold the relative or absolute truncation error within bounds fixed by the user. A FORTRAN listing of the subroutine is included in this report.

ON THE EQUIVALENCE PROBLEM FOR FORMALIZED COMPUTER PROGRAMS

D. Luckham, Bolt Beranek, and Newman, Inc., Cambridge, Mass., In its Techniques of Simplification, March 29, 1963, p. 23/43, 2 refs., N63-18429.

. . . an abstract programing language is developed in which programs with an infinite number of possible execution sequences may be represented. The problems of equivalence and simplification of programs in the language are discussed, and a necessary and sufficient condition for the equivalence of programs is found.

BIBLIOGRAPHY ON LANGUAGES RELATED TO COMPUTERS

C. F. G. Lyau, Autonetics, Downey, Calif., Rept. no. T4 483 3111, 31 March 1964, 62 p., AD 435 807.

. . . (1) the philosophy, structure and design of Compute Languages; (2) the analysis and interpretation of Natural Languages as related to Computers. . . . 178 references . . . include books, reports, papers and periodical articles . . . covered the periods 1946 through 1963.

FORTRAN SUBROUTINES FOR TIME SERIES DATA REDUCTION

R. A. MacGowan, ACM, Communications, vol. 7, March 1964, p. 153/157, 10 refs., A64-15160.

. . . reduction of typical guided missile test data. It is assumed . . . that real-time data reduction is not required.

NABUR A NAREC ASSEMBLER FOR THE BURROUGHS D825 MODULAR DATA-PROCESSING COMPUTER

R. M. Mason, et al., Naval Research Lab., Washington, D. C., 13 Jan. 1964, 51 p., AD 436 591.

. . . an assembly routine written for the Naval Research Electronic Computer (NAREC) produces object programs suited to the Burroughs D825 . . .

AN EXPERIMENTAL INVESTIGATION OF A CLASS OF PATTERN RECOGNITION SYNTHESIS ALGORITHMS

R. L. Mattson, et al., IEEE Trans. Electronic Comp., EC-12, vol. 3, June 1963, p. 300/306.

This paper discusses a class of pattern-recognition decision-making procedures which can be efficiently mechanized by a network of linear threshold devices. A theoretical discussion of four decision techniques (which are members of the above-mentioned class) is augmented by an experimental program which investigates questions not amenable to analysis.

A GENERALIZED ASSEMBLY SYSTEM
G. H. Mealy, Rand Corp., Santa Monica, Calif., RM3646PR, Aug. 1963, 71 p., AD 411 835.

. . . research . . . to consolidate and extend . . . the art of computer assembly system design . . . The importance of proper design of assembly systems is especially apparent in the implementation of such large programs as the control programs for SAGE and SACCS. The vehicle for this research has been the Generalized Assembly System (GAS), programmed in an experiment form for the IBM 7090 Data Processing System. . . .

INTRODUCTION TO SEMI-AUTOMATED MATHEMATICS. SECTION I: A PROGRAMING LANGUAGE FOR NATURAL DEDUCTION: SECTION II: AXIOMATIC THEOREM PROVING
T. H. Mott, Jr., et al., International Research Inst., Princeton, N. J., Final Report, April 15, 1963, 78 p., N63-20437.

PROCESSING OF ALPHANUMERIC DATA IN FORTRAN
B. B. Occhipitini, DuPont de Nemours (E. I.) and Co., Aiken, S. C., Savannah River Lab., (DP-822), June 1963, 45 p., 1 ref., N63-21037.

GENORO, A GENERAL DATA FITTING AND LINEAR FUNCTIONAL EVALUATION COMPUTER CODE FOR THE IBM 7090
C. A. Oster, Hanford Atomic Products Operation, Richland, Wash., July 8, 1963, 64 p., 4 refs., N63-19614.

The GENORO computer code permits: (1) the determination of the best fitting functional for a given set of data points, (2) the evaluation of the functional obtained in (1), or (3) the evaluation of any other functional of the same form. . . .

A PROPOSITION TO INTRODUCE A NEW INTERNATIONAL BUSINESS ORIENTED SYMBOLIC PROGRAMMING LANGUAGE NAMED MONEY USING NUMERIC CHARACTERS ONLY
E. T. A. Rechnitzer, Royal Danish Air Force, Copehagen (Denmark), RDAF RZ631101. Nov. 1963, 1v., AD 424 158.

AN EXTENSION OF ALGOL-LIKE LANGUAGES
G. F. Rose, Systems Development Corp., Santa Monica, Calif., Scientific Report No. 4, AFCRL-63-181, May 21, 1963, 78 p., 5 refs., N63-19508, AD 408 644.

The notion of definability is modified to obtain a family of "extended definable sets." This modification was suggested by certain examples of nondefinable sets connected with program-oriented languages. The definable sets form a proper subfamily of the extended definable sets. . . . Notable examples of operations under which the family of definable sets is closed and the family of extended definable sets is not closed include substitution of finite sets for symbols, formation of subwords, and the machine operation.

ALGORITHMS FOR THE ENCODING OF THREE-DIMENSIONAL GEOMETRIC FIGURES
K. Ruttenberg, Laboratory for Electroscience Research, New York Univ., June 1963, 1 v., AD 434 320.

Procedures are developed for the chain encoding of linear, planes, conic sections, and quadric surfaces. Encoding of geometric figures in terms of chains facilitates their analysis and manipulation with a digital computer. . . .

THE LOGIC DESIGN OF ADAM, A PROBLEM-ORIENTED SYMBOL PROCESSOR (Final Report)
R. F. Schauer, et al., International Business Machines Corp., Yorktown Heights, N. Y., Thomas J. Watson, Research Center, AFCRL-63-510, 19 Aug. 1963, 264 p., AD 428 316, N64-16431.

. . . general description of the language and a detailed design of a machine organization having the following characteristics: complete symbolic addressing on variable field length data; list and string operation; high-to-low-order numeric processing; dynamic storage allocation; and automatic input/output. . . .

THE LOGIC DESIGN OF ADAM, A PROBLEM-ORIENTED SYMBOL PROCESSOR PROGRAMMING MANUAL (Appendix I)
R. F. Schauer, et al., T. J. Watson Research Center, Yorktown Heights, N. Y., AFCRL 63 510, 19 Aug. 1963, 79 p., AD 428 726.

. . . presents the coding techniques which will be used to prepare problems for solution on ADAM, an experimental digital data handling system. . . . ADAM has a character set with 128 assigned characters (those assigned to hardware functions) and 128 general characters. . . .

THE LOGIC DESIGN OF ADAM, A PROBLEM-ORIENTED SYMBOL PROCESSOR (Appendix II. Logic Drawings)
R. F. Schauer, et al., T. J. Watson Research Center, Yorktown Heights, N. Y., Final rept., AFCRL 63 510, 19 Aug. 1963, 133 p., AD 428 316.

A SPECIFICATION OF JOVIAL
C. J. Shaw, System Development Corp., Rept. no. SP1315, Aug. 1963, 16 p., AD 437 371, Commun. ACM, vol. 6, no. 12, p. 721/736, Dec. 1963.

A PRIMER ON THE ACT-III COMPILER FOR THE LGP-30 DIGITAL COMPUTER
H. C. Thacher, Jr., et al., Argonne National Lab., Ill., ANL-6697, Oct. 1963, 96 p., N64-13398.

AN ALGORITHM FOR MINIMAX POLYNOMIAL CURVE-FITTING OF DISCRETE DATA
C.W. Valentine, et al., J. Assoc. Comput. Machinery, vol. 10, July 1963, p. 283/290, A63-21006.

. . . shown that the special properties of the Vandermonde matrix and its generalizations permit a great reduction in the computations needed in applying the algorithm. . . .

A PROGRAM FOR THE EXECUTION OF LGP-30 MACHINE-LANGUAGE CODES ON THE NAREC COMPUTER
E.E. Wald, et al., Naval Research Lab., Washington, D.C., NRL Rept. no. 5919, 1 July 1963, 107 p., AD 419 550.

In order to allow the utilization of digital computer programs written for the LGP-30 computer . . . a program was written for NAREC . . . which causes NAREC to simulate the actions of an LGP-30. . . .

THE COMPOSITE SIMPLEX ALGORITHM: NOTES ON LINEAR PROGRAMMING AND EXTENSIONS —Part 64
P. Wolfe, RAND Corp., Santa Monica, Calif., RM-3579-PR, April 1963, 44 p., 11 refs., N63-16997.

. . . process of finding a feasible solution of a linear programing problem by means of the simplex method. It is shown how certain rules regarding the details of the process result in a procedure called the "composite" algorithm, presently used in several linear programing computer routines. Experimental evidence for the efficiency of the procedure is given.

SOME ALGORITHM THEORY AND ITS APPLICABILITY
A.P. Zeleznikar, Nuklearni Institut Josef Stefan, Ljubljana (Yugoslavia), Submitted for Publication NIJS-R-418, Oct. 1963, 18 p., refs., N64-15839.

An exact definition of the general notion of an algorithm was first introduced by A.A. Markov. The new idea of an algorithm described in this article has many concepts in common with normal algorithms . . .

ASAP, AN AUTOMATED STATISTICAL ANALYSIS PROGRAM
International Business Machines Corp., Poughkeepsie, N.Y., Part One (of) Two-Part Final Report, 1963, 45 p. refs., N64-16735.

. . . ASAP does not require that the circuit equations be written and solved to produce a Monte Carlo statistical analysis. By using a nodal description of the circuit in an English text, free-format input style, ASAP will write the circuit equations, solve them algebraically, write and compile a FORTRAN subroutine, and run the statistical analysis . . .

A STUDY OF METHODS FOR REPRESENTING DATA STRUCTURE
Mitre Corp., Bedford, Mass., ESD TDR63 241, June 1963, 58 p., W5570, AD 410 920.

. . . catalogue of various methods of representing the structure of data in a computer, and an evaluation of those methods . . .

Related Publications:

APPLICATIONS OF BOOLEAN MATRICES TO THE ANALYSIS OF FLOW DIAGRAMS
R.T. Prosser, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 133/138.

The author limits himself in this paper to questions of connectivity in the flow diagram of a program, and properties of the individual boxes, representing program operations, are not considered.

THE OPTIMAL ORGANIZATION OF SERIAL MEMORY TRANSFERS
A. Gill, IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 12/15.

. . . The procedure described for optimizing serial transfers is readily programmable for computer execution . . .

A METHOD FOR RESOLVING MULTIPLE RESPONSES IN A PARALLEL SEARCH FILE

E.H. Frei, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 718/722.

. . . The testing algorithm is easily mechanized, and the number of test required per item is approximately proportional to the logarithm of the number of file registers.

A LOGIC DESIGN TRANSLATOR
B.F. Gorman, et al., Proc. A FIPS Fall Joint Computer Conf., Dec. 1962, p. 251/261.

. . . is a program written for the Burroughs 220 which accepts the description of the logic design of a computer in a special language based on an informal programmatic notation currently in use, and transforms these into application equations.

THE HANDLING OF MULTIWAY TABLES ON COMPUTERS
J.C. Gower, Computer J., vol. 4, Jan. 1962, p. 280/286.

Computer routines for scanning multi-argument tables and computing arithmetic functions of numerical data stored in a subset of such a table . . .

A DIGITAL COMPUTER CODE FOR THE ANALYSIS OF THERMIONIC NETWORKS
J. H. Broido, et al., General Atomic Div., General Dynamics Corp., San Diego, Calif., GA4147, 22 May 1963, 75 p., AD 406 283.

. . . describes the performance of thermionic diodes has been developed. Detailed data derived from physics research on operating thermionic diodes are incorporated in the library of this code . . . Preparation of input, the FORTRAN listing of the program, and the data library for tungsten emitters are given in the Appendices . . .

CONVERSION FROM POSITIVE TO NEGATIVE AND IMAGINARY RADIX (Correspondence)
D. L. Dietmeyer, IEEE Trans. Electronic Comp., vol. EC-12, no. 1, Feb. 1963, p. 20/22.

Wadel has given an algorithm for converting a number from positive binary to negative binary. Knuth has listed rules for conversion from quaternary (+4) to the radix -4 number system. Both algorithms are special cases of the rules . . . for converting from the +R to the -R number system.

HIGH SPEED DECIMAL INPUT AND OUTPUT ROUTINES FOR THE PB-250 COMPUTER
C. D. Maunsell, Pacific Naval Lab. (Canada), PNL TM63 4, March 1963, 19 p., AD 410 468.

. . . includes a high-speed paper tape reader and a high-speed tape punch . . . Programming techniques have been developed for use in high-speed decimal input and output routines. Applications of these techniques are illustrated in specifications, coding sheets and flow diagrams for two decimal input-output routings.

AN INTERPRETIVE FLOATING POINT SUBROUTINE FOR THE PB-250
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 36/38.

Floating point arithmetic operations can be performed with a short PB-250 subroutine. . . . disadvantage of requiring a complicated entry procedure for each floating point operation executed.

In order to facilitate the use of this subroutine, additional commands were added in the vacant sectors of the long storage line. These commands serve as a driver for the floating point subroutine, and the ultimate result is a simplified three address interpretive floating point subroutine.

Section 3A.15

3A.150: Programming and Coding of Computers

Included: Programming techniques; Heuristic programs; Special programs for space electronics applications; Space guidance computer programs; Space tracking computer programs; Programming of special computers; Information theory of programming techniques; Coding methods; Management of programming activities.

Not Included: Programs for routine operation of commercial computers.

Cross References: Micro-programming methods (3A. 140); Macro-programming methods (3A.140); Descriptions of operational computers (3A.020 and 3A.080).

Principal Publications:

PROGRAMMING THE LOGIC THEORY MACHINE
A. Newell, et al., RAND Corp., Santa Monica, Calif., Rept. no. P954, Rev. 28 Feb. 1957, 39 p., AD 422 567.

. . . The program itself is a large, complicated hierarchy of subroutines. . . .

A DIGITAL COMPUTER PROGRAM FOR REDUCING LOGICAL STATEMENTS TO A MINIMAL FORM
K. J. Butler, Jr., et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 456/466.

. . . The reduction method is a modification to the method of Harris[1] which utilizes an n-dimensional cube for representing the logical statement. The computer program makes use of the directional components present in the topological representation of the logical statement . . .

PROGRAMMING FOR DIGITAL COMPUTERS
J. Jeenel, New York, McGraw-Hill Book Co., 1959.

. . . a systematic presentation of the standard detailed problems one encounters when programming a computer directly in machine language. . . . flow diagrams.

ANNUAL REVIEW IN AUTOMATIC PROGRAMMING, VOL. I
R. Goodman, (Editor), New York, Pergamon Press, Inc., 1960, 310 p.

. . . an Automatic Programming Information Center at Brighton with the aims of establishing a permanent collection of material on automatic programming . . .

FACTORS INFLUENCING THE RESEARCH AND DEVELOPMENT OF NEW COMPUTER PROGRAMMING TECHNIQUES REQUIRED FOR MECHANIZATION OF MACHINE LEARNING
R. E. Smith, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 173/178.

DIGITAL PROGRAMMING FOR THE INVERSION OF Z TRANSFORMS (Correspondence)
J. T. Tou, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 373.

. . . This note describes a digital program for the long-division inversion of Z transforms.

THREE-DIMENSIONAL RAY TRACE COMPUTER PROGRAM FOR ELECTROMAGNETIC WAVE PROPAGATION STUDIES
W. F. Dudziak, Technical Military Planning Operation, General Electric Company, Santa Barbara, Calif., 1 May 1961, 170 p., AD 404 907.

. . . FORTRAN. . . . permits the computation of detailed ray patterns portraying the spatial distribution of rays emitted from a transmitter whose geographic coordinates with respect to the center of the earth are known.

ELEMENTS OF PROGRAMMING (In Russian)
B. V. Gnedenko, V. S. Korolyuk, Y. L. Yushchenko, Moscow, Fizmatgiz, 1961, 348 p.

. . . may serve as a handbook for programming in digital computers. Its contents reflect investigations in the field of automatic programming, solution of logical problems by digital computers, and also the operator method proposed by A. A. Lyapunov.

PROGRAMMING AND NUMERICAL METHODS
H. D. Leeds and G. M. Weinberg, New York, McGraw-Hill Book Co., Inc., 1961, 368 p.

MULTI-LEVEL PROGRAMMING FOR A REAL-TIME SYSTEM
A. B. Shafritz, et al., Proc. Eastern Joint Computer Conf., Dec. 1961, 1/17.

. . . an advanced procedure for sequencing real-time operations of a processor equipped with multiple, asynchronous input-output units.

SIMULATION AND ANALYSIS OF BIOCHEMICAL SYSTEMS. PART III. ANALYSIS AND PATTERN RECOGNITION
D. Garfinkel, et al., Commun. ACM, vol. 5, Feb. 1962, p. 115/118.

Programs for handling the reduction of the large amounts of data generated in solving the differential equations representing chemical systems are described. Two main programs, MASTER EDIT I and MASTER EDIT II, compress the information into library storage form, retrieve required information and recognize certain basic patterns.

SCF COMPUTER PROGRAM SYSTEMS MANUAL UTILITY PROGRAMS INTRODUCTION AND TABLE OF CONTENTS
C. L. Hill, et al., System Development, Corp., Santa Monica, Calif., 25 April 1962, 4 p., AD 402 661.

PROGRAMS FOR MACHINE LEARNING
A. M. Hormann, Inform. Control, vol. 5, no. 4, Dec. 1962, p. 347/367.

PROGRAMS FOR MACHINE LEARNING. PART II
A. M. Hormann, System Development Corp., Santa Monica, Calif., Rept. no. Sp1404, 13 July 1962, 23 p., AD 437 374.

COMPUTATIONAL CHAINS AND THE SIMPLIFICATION OF COMPUTER PROGRAMS
T. Marill, IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 173/180.

In the synthesis of switching circuits, a formal representation of the function to be realized by the circuit is first established and simplified as much as possible. Only then is construction of the circuit undertaken. It is argued that an analogous strategy should be followed in the synthesis of digital computer programs . . .

COLLECTION OF COMPUTER PROGRAMS APPLICABLE TO METEORLOGICAL DATA PROCESSING
W. D. Mount, et al., Air Force Cambridge Research Labs, Bedford, Mass., Rept. no. AFCRL-62-1098, Nov. 1962, 56 p., AD 298 738.

MAGNETIC TAPE COPIES OF MIT GEOPHYSICS PROGRAM SET I (Time Series Programs for the IBM 709, 7090)
S. M. Simpson, Jr., Mass. Inst. of Tech., Cambridge, Scientific rept. no. 4, AFCRL 63-282, 30 Dec. 1962, 47 p., AD 299 069.

GGC-II. A PROGRAM FOR USING THE GAM-II AND GATHER-II SPECTRUM CODES IN PREPARING MULTIGROUP CROSS-SECTION INPUT ON PUNCHED CARDS FOR THE GAZE, GAZED, DSN GAPLSN, 2DXY, TDC, GAMBLE, FEVER, AND GAD CODES
C. V. Smith, et al., General Dynamics Corp., San Diego, Calif., 17 Dec. 1962, 35 p., refs., N64-15526.

. . . programmed for use on an IBM-7090 computer with a 32K memory, is written for the most part in the FORTRAN-II language . . . The program operates under the standard 32K FORTRAN Monitor System . . . requires eleven tape units on two data channels, not including the system monitor (and system library tape, if separate) . . .

PROGRAM TO COMPUTE INTERMODULATION PRODUCTS
D. Wiggert, et al., Lincoln Lab., Mass. Inst. of Tech. Lexington, Nov. 16, 1962, 18 p., N63-21725.

. . . written in the SHARE 709 system (SOS) for the IBM 7090 computer to calculate all intermodulation products up to and including sixth order for any number of input frequencies and bandwidths consistent with core storage limitations. Interfering products are written out using OUTRAN as they are calculated and detected.

SPACE DETECTION AND TRACKING SYSTEM (SPADATS) SEMI-AUTOMATIC CENTER PROGRAMMING DOCUMENT (Revised)
Aeronutronic, Newport Beach, Calif., Rev. 1 Oct. 1962, lv., Pub. no. U1691, ESD TDR 63 327, AD 420 025.

COMPUTER PROGRAM REVIEWS
IRE Trans. Circuit Theory, vol. CT-9, no. 3, Sept. 1962, p. 307.

. . . This column will appear in these Transactions whenever material is available. Contributions offered for review should be available to IRE members on request . . .

AN APPLICATION OF HEURISTIC PROGRAMMING TO THE PROBLEM OF THEOREM PROVING BY MACHINE
S. Amoroso, Army Electronics Research and Development Agency, Fort Monmouth, N. J., AELRDL TR2345, March 1963, 16 p., AD 403 761.

A mechanical procedure using trial and error techniques is outlined which will verify, in a large number of cases, the validity of an argument form expressed in quantification theory. . . . implementation for a digital computer . . .

A GENERAL PERTURBATIONS DIFFERENTIAL CORRECTION PROGRAM
J. L. Arsenault, et al., Aeronutronic, Newport Beach, Calif., Pub. U2201, ESD TDR 63 432, 1 Aug. 1963, 147 p., AD 419 144.

An experimental computer program is described, which calculates Earth Satellite ephermerides, corrects orbit elements and evaluates the effects of various terms of the bulge perturbation theory. Perturbations by solar radiation pressure and atmospheric drag are also represented. . . . employs a weighted least-squares reduction. . . .

SHIELDING REQUIREMENTS FOR ELECTRONIC COMPONENTS IN RADIATION ENVIRONMENTS
A. J. Beck, et al. Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 588/602, 20 refs.

. . . Realistic radiation environmental models are selected for use with radiation shielding analyses programmed for the digital computer. These programs evaluate the radiation levels in shielded compartments resulting from 1) primary protons, 2) primary electrons, and 3) secondary radiations produced in the protective shielding such as neutrons, gamma rays, and bremsstrahlung.
Radiation levels computed by means of these programs are presented for flights in the natural and artificial radiation belts and for missions exposed to typical solar flare events and galactic cosmic radiation.

160-A REFERENCE MANUAL
R. P. Bennett, et al., Systems Development Corp., Santa Monica, Calif., Rept. no. TM-(L)-993, 8 Feb. 1963, lv, 7 refs., AD 401 452.

A DESCRIPTION OF THE COMPUTER PROGRAM IMPLEMENTATION PROCESS: A PROCESS FLOW
R. E. Bleier, System Development Corp., Santa Monica. Calif., Rept. no. TM 1021 003 00, 9 May 1963, 8 p., AD 410 196.

. . . has as its objective the analysis and identification of management techniques for large computer programming jobs in command-control system development. A flow diagram that illustrates one of several ways in which the computer program implementation process occurs is presented.

ROCKET: RAND'S OMNIBUS CALCULATOR OF THE KINEMATICS OF EARTH TRAJECTORIES
B. Boehm, RAND Corp., Santa Monica, Calif., RM-3534-PR, July 1963, 278 p., 18 refs., N63-19781.

. . . capabilities and basic theory of ROCKET, a digital computer program written in FORTRAN II, are presented. . . . mathematically simulates the flight of a multistage rocket vehicle about a rotating oblate planet with a rotating atmosphere; or any less elaborate trajectory conditions. . . . Numerous examples are included to provide operational definitions for the various options in the program and to show its uses as a research tool. The computational subroutines and operational aspects of the program are presented.

SHLOG-A DATA RETRIEVAL PROGRAM FOR THE PHILCO-2000
H. Bohl, Jr., et al., Bettis Atomic Power Lab., Pittsburgh, Pa., Sept. 1963, 57 p., N64-10990.

A USER'S GUIDE TO BOMM. A SYSTEM OF PROGRAMS FOR THE ANALYSIS OF TIME SERIES
E. C. Bullard, et al., Institute of Geophysics and Planetary Physics, La Jolla, Calif., April 1964, 118 p., AD 436 430, AD 435 778.

. . . causes an electronic computer to perform arithmetic operations on time series. . . . main objectives were: (1) to enable a wide variety of data formats to be accepted without recoding; (2) to allow gross errors to be removed automatically from the data; (3) to provide a considerable variety of arithmetic operations and leave the user free to choose the order in which they are applied; and (4) to allow further processes to be incorporated into the system. . . .

ACQUISITION PROGRAM FOR TRACKING AND SURVEILLANCE OF EARTH SATELLITES
A. P. Callanan, et al., Aeronutronic, Newport Beach, Calif., Rept. no. U1854, Oct. 1963, 72 p., AD 421 692.

A computer program has been developed to calculate acquisition coordinates of earth satellites for tracking sensors and for fixed beam surveillance sensors. . . . This computer program may be used to simulate sensor-satellite patterns or to generate calculations for real satellites and existing sensors.

DETERMINATION DES VALEURS ET VECTEURS PROPRES REELS D'UNE MATRICE (Determination of Exact Real Values and Vectors of a Matrix) (In French)
A. Castells, et al., International Symposium on Analogue and Digital Techniques Applied to Aeronautics, Liege, Belgium, Sept. 9-12, 1963, Paper, 17 p., AD64-16454.

AN INFORMATION-THEORETICAL MODEL APPLIED TO COMPUTER PROGRAMS
W. R. Cowell, Argonne National Lab., Ill. Applied Mathematics Div., ANL-6722, June 1963 20 p., 5 refs, N63-21206.

. . . to describe the match between a message and a communication channel. Also the model is interpreted so as to describe the match between a particular computation and a given instruction repertoire for a computer . . . a series of measurements which were made with IBM 704 programs are described.

SPINNING UNGUIDED ROCKET TRAJECTORY DIGITAL COMPUTER PROGRAM (SPURT)
A. D. Dayton, Air Force Special Weapons Center, Kirtland AFB, N. Mex., AFSWC TDR63 11, Feb. 1963, 225 p., AD 404 815.

. . . is a five-degree-of-freedom trajectory digital computer program for spinning unguided space probe vehicles. . . . for the Control Data Corporation, 1604 digital computer . . . All input and output data are in geodetic coordinates.

SCHOPS/SWITCH CONTROL INTERFACE DOCUMENT
M. A. Franks, System Development Corp., Santa Monica, Calif., Technical memo TM(L)-832/000/01, 1 March 1963, 21 p., AD 401 451.

SCHOPS is a scheduling program designed and written for the CDC 1604, which allocates the use of specified pieces of equipment or equipment complexes at the Satellite Test Annex (STA), and remote tracking stations for tasks on a temporal basis.

INVESTIGATED INTO THE SPECIAL PROGRAMMING NEEDS FOR AUTOMATED LABORATORY FOR PSYCHOLOGICAL RESEARCH
E. Fredkin, Information International, Inc., Maynard, Mass., ESD TDR63 353, 30 May 1963, 45 p., AD 427 103.

A COMPUTING PROGRAM FOR DETERMINING CERTAIN STATISTICAL PARAMETERS ASSOCIATED WITH POSITION AND VELOCITY ERRORS FOR ORBITING AND RE-ENTERING SPACE VEHICLES
R. T. Gabler, et al., RAND Corp., Santa Monica, Calif., RM3609PR, April 1963, 47 p., AD 405 303.

A PEGASUS COMPUTER PROGRAMME FOR ESTIMATING ERRORS IN THE EPHEMERIS OF A SATELLITE, WITH AN APPLICATION TO ARIEL I
R. H. Gooding, Royal Aircraft Establishment, Farnborough (England), RAE Technical note no. space 37, July 1963, 24 p., AD 420 396.

. . . errors . . . can be estimated from the covariance matrix of errors in the orbital parameters. The program is used to show that orbital parameters of Ariel 1 derived from Minitrack data are good enough for the position of Ariel to be computed to within 1 km. . . .

UTILITY PROGRAM DESCRIPTIONS MILESTONE II. TEST CONTROL PROGRAM (STCP) FOR THE PARAMETER TEST SYSTEM
E. L. Griffith, System Development Corp., Santa Monica, Calif., TM715 041 00, 25 April 1963, 95 p., AD 413 886.

UTILITY PROGRAM DESCRIPTIONS MILESTONE II, SQUARE ROOT PROGRAM (SQRT)
E. L. Griffith, System Development Corp., Santa Monica, Calif., Rept. no. TM715 067 00, 14 Nov. 1963, 8 p., AD 427 888.

. . . computes the square root of a floating point number. The square root is determined by the Newton - Raphson method. The root is taken in two parts, the exponent and the mantissa . . .

AN IBM 650 PROGRAM FOR A COMPLETE PAIRED COMPARISON SCHEDULE (PARCOPLET-2-21)
H. Gulliksen, Educational Testing Service, Princeton, N. J., May 30, 3 p., AD 418 264.

The method of paired comparisons and the of comparative judgement provides a calling method with accurate checks on the goodness of fit of the data to the theory. An IBM 650 program has been prepared that will handle a complete paired comparison schedule for any number of objects up to and including 21 . . .

A PROGRAMMING SYSTEM FOR COMMAND AND CONTROL APPLICATION
M. Halpern, Lockheed Missiles and Space Co., Sunnyvale, Calif., Technical Report , LMSC-5-10-63-26, July 25, 1963, 54 p., refs., N63-22993.

. . . (1) the special problems and requirements of command and control computer programing; a macroprocessing programing system . . . A brief annotated bibliography of current periodical literature . . .

MANAGEMENT OF COMPUTER PROGRAMMING FOR COMMAND AND CONTROL SYSTEMS
K. Heinze, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM-903/-000/01, 20 Feb. 1963, 48 p., AD 401 351.

Findings in a survey of seven computer programming efforts for command and control systems . . . computer programming, including its growth, military use, and personnel . . . Recommendations are made for improving the identification of program activities and products by establishing a common technical language and other means.

MANAGEMENT OF COMPUTER PROGRAMMING FOR COMMAND ANC CONTROL SYSTEMS A SURVEY
K. Heinze, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM903 000 02, 8 May 1963, 43 p., AD 415 721.

A PROGRAM FOR THE DETERMINATION OF THE AUTOCORRELATION FUNCTION AND POWER SPECTRUM ON THE IBM 650 TAPE-RAMAC COMPUTER SYSTEM
R. S. Huntzinger, Aeronautical Computer Lab., Naval Air Development Center, Johnsville, Pa., RADC AC 6403, 26 March 1964, 42 p., AD 436 410.

COMPUTER PROGRAMS FOR SPECTRAL ANALYSIS OF ECONOMIC TIME SERIES. ECONOMETRIC RESEARCH PROGRAM
H. F. Karreman, Princeton U., N. J., 15 July 1963, 100 p., AD 418 321.

COMPUTER PROGRAM REFERENCE MANUAL OF THE HUDSON LABORATORIES COMPUTING FACILITY. VOLUME I. BASIC UTILITY PROGRAMS
M. Klerer (editor), Hudson Labs., Columbia U., Dobbs Ferry, N. Y., Rept. no. TR105, May 1963, lv., AD 429 723

Write-ups are given for the following programs: Square Root, Sine, Cosine, Log sub e, Log sub ten, Log sub two, Arctangent, Arcsine, Arcosine, Exponential, Decimal to Binary, Free Field Input, Binary to Decimal, Decimal Output, TYPE, Blank, TRACE, PRINT OCTAL . . . Power Spectrum, Autocorrelation and Power Spectrum II. These programs have been coded for a GE-225 Computer.

SOVIET CYBERNETICS TECHNOLOGY: III, PROGRAMMING ELEMENTS OF THE BESM, STRELA, URAL, M-3, AND KIEV COMPUTERS
A. S. Kozak, RAND Corp., Santa Monica, Calif., Memo. no. RM 3804PR, Sept. 1963, 70 p., AD 419 487.

. . . translation of the Appendix of the book, Elements of Programming. The book itself is a general introduction to the subject of electronic computing, with particular emphasis on serving as a guide to programmers. . . . the Appendix . . . details the command structures and systems of notation for the five Soviet computers . . . some specifications for each of the computers are included. . . . It also contains comments on the problems one encounters in trying to make analyses of the Soviet state of the art, pointing out the vast differences that are found when comparing two different authors' comments on the same machine.

THE DEGARBLER-A PROGRAM FOR CORRECTING MACHINE-READ MORSE CODE
C. K. McElwain, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, 25 Oct. 1963, 17 p., AD 405 394.

An IBM 7090 program automatically corrects garbled samples of English text. The garbles are intended to resemble those caused by Morse Code transmissions. The program has access to a vocabulary and a table of the Morse Code equivalents of the English alphabet. The correction rate on text in which 0-10% of the characters have been subjected to Morse Code garbles is about 70%. The apparent improvement in intelligibility is very marked.

A DETERMINISTIC APPROACH TO SYSTEMS OF COMMUNICATION SATELLITES
M. Mannos, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 268/271.

. . . A general computer program is now being written to determine the communication potential of a system of satellites for any preselected pair combinations of prescribed stations, any one of which may be either in space or on the ground. . . .

HEURISTIC PROGRAMS-FACT, FAD, OR FUTILITY
S. J. Mathis, Jr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 177/181.

PROGRAM FOR THE LOCATION OF FOURIER PEAK CENTERS
M. H. Mueller, et al., Argonne National Lab., Ill, Metallurgy Div., Texas U., ANL-6699, July 1963, 34 p., 5 refs., N63-22754.

INTRODUCTORY PROGRAMMING FOR ORDVAC AND BRLESC: FORAST (Formula and Assembly Translator)
M. J. Romanelli, Aberdeen Proving Ground, Md., BRL Rept. 1209, July 1963, 207 p., 1 ref., N63-22381.

. . . FORAST is a programming language designed for use on ORDVAC and BRLESC, the high-speed digital computers of the Ballistic Research Laboratories . . . Fundamental concepts and details of the language are illustrated in many examples so that the novice is taught how to program and obtain practical solutions for a variety of mathematical problems.

SATELLITE COMPUTER PROGRAM DESCRIPTION MILESTONE 5 COMPUTER SHADOW TIMES (SHADOW)
C. M. Seacat, et al., System Development Corp., Santa Monica, Calif., 22 May 1963, 32 p., AD 408 552.

SHADOW is a 1604 COp-controlled program to compute the times at which a satellite enters and leaves the shadow of the earth. Results are printed on-line and off-line.

ANSWERING ENGLISH QUESTIONS BY COMPUTER: A SURVEY
R. F. Simmons, System Development Corp., Santa Monica, Calif., Rept. no. SP1556, 2 April 1964, 64 p., AD 437 610.

Fourteen question-answering systems which are more or less completely programmed and operating are described and reviewed. The systems range from a conversation machine to programs which make sentences about pictures and systems which translate from English into logical calculi. Systems are classified as data based, text based, and inferential. . . .

A GENERAL UTILITY CORRELATION PROGRAM FOR IBM 709 WITH PROVISIONS FOR MISSING DATA
R. C. Sorenson, et al., Washington U., Seattle, Jan. 1963, 12 p., AD 413 481.

NEW 1604 COMPUTER PROGRAMS MILESTONE V INPUT TRACKING DATA (STAPIN)
N. Speer, System Development Corp., Santa Monica, Calif., Technical memo TM-(L)-793/003/00, 22 Jan. 1963, 23 p., AD 402 208.

STAPIN (Input Tracking Data) is a closed subroutine that reads all tracking data, formats and stores them in the locations specified by the user program, and, if requested, provides a BCD listing of the data points for off-line printing.

GENERAL PURPOSE SATELLITE COMPUTER PROGRAM DESCRIPTIONS MILESTONE II REFERENCE AND INTERCOMMUNICATION POOL (RIPOOL)
M. A. Tanous, System Development Corp., Santa Monica, Calif., Rept. no. TM714 035 02, 3 March 1964, 13 p., AD 437 620.

RIPOOL provides a communication link between a function and its subroutines or between the subroutines of a function. Also it is reported that TIPOOL contains many commonly used quantities such as geophysical constants and provides storage for orbital parameters and other variables.

SOVIET CYBERNETICS TECHNOLOGY, III: PROGRAMMING ELEMENTS OF THE BESM, STRELA, URAL, M-3, AND KIEV COMPUTERS
W. H. Ware, et al., RAND Corp., Santa Monica, Calif., RM-3804-PR, AD 419 487, Sept. 1963, 87 p., refs., Transl. into English of an appendix from the book "Elementy Programmirovaniya", N64-16046.

. . . a translation of the appendix of the book Elements of Programming. It details the command structures and systems of notation for the five Soviet computers . . .

A FORTRAN PROGRAM TO CALCULATE A BALLISTIC MISSILE TRAJECTORY FROM LAUNCH OR ANY POINT THEREAFTER TO IMPACT
W. B. Warren, Brown Engineering Co., Huntsville, Ala., Tech. note. no. R84, Dec. 1963, 35 p., AD 432 285.

. . . computes a two-dimensional, point mass ballistic trajectory from any point, either during burning or after burnout, to any point thereafter to impact. . . . takes into account air resistance and the variation of the gravitational field with altitude. . . . written in FORTRAN IV for the IBM 7040 computer.

ENGINEERS' MANUAL - DYNASAR III
J. M. Watson, General Electric Co., Advanced Technology Labs., Schenectady, N. Y., Rept 63GL36, 1 Jan. 1963, 114 p., 5 refs., N63-19197.

The Dynamic Systems Analyzer, DYNASAR, is a digital computer program for the study of dynamic systems. It uses simulation and response techniques similar to those of this analog computer. It is suitable for the evaluation of large, complex, linear and nonlinear systems describable by differential and algebraic equations. Computationally, DYNASAR is a general-purpose engineering-processing program programed for the IBM 704 and 7090 computers.

A FORTRAN PROGRAM TO CALCULATE BESSEL FUNCTIONS OF INTEGRAL INDEX AND COMPLEX ARGUMENT
J. E. White, Jr., Brown Engineering Co., Inc., Huntsville, Ala., Scientific Research Labs., July 1963, 35 p., 5 refs., N63-22562, AD 416 797.

CL-II PROGRAMMING SYSTEM IBM 7090 VERSION PROGRAM DESCRIPTIONS. VOLUME I. CONTROL
Computer Associates, Inc., Woburn, Mass., Rept. no. CA63 6SD, 6 Aug. 1963, AD 420 021.

The executive control for CL-II (called Control) provides macro facilities and primitive routines to perform tape positioning, I/O transmission, interrupt handling, memory allocation, program path selection and execution, etc. Detailed specifications and flow charts for Control are given. . . .

CL-II PROGRAMMING SYSTEM IBM 7090 VERSION. PROGRAM DESCRIPTIONS, VOLUME I. APPENDIX B. CONTROL NAMES AND EQUIVALENCES
Computer Associates, Inc., Woburn, Mass., Rept. no. CA63 1SD, 15 April 1963, 50 p., AD 420 194.

CL-II PROGRAMMING SYSTEM IBM 7090 VERSION. PROGRAM DESCRIPTIONS. VOLUME 2, ESTABLISH
Computer Associates, Inc., Woburn, Mass., Rept. no. CA63 2SD, 17 April 1963, lv., AD 420 063.

COMPUTER PROGRAM REFERENCE MANUAL OF THE HUDSON LABORATORIES COMPUTING FACILITY
Hudson Lab., Columbia U., Dobbs Ferry, N. Y., Tech. rept. no. 110 and 111 respectively, May 1963, 106 p. and 73 p., respectively, AD 433 490, 433 491.

MILESTONE 4, MSAP TRACKING STATION OPERATIONAL COMPUTER PROGRAM DESIGN SPECIFICATIONS
Philco Corp., Palo Alto, Calif., Technical Operating rept., Rept. no. WDL-TR1957, 4 Feb. 1963, lv., illus., 2 refs., AD 296 316.

A design specification is outlined for an operational computer program that services satellites at remote tracking stations in the Satellite Control Facility, Multi-Satellite Augmentation Program, network. . . . will be used at remote tracking sites in support of satellite acquisition, tracking, commanding, telemetry, and station control operations.

FIRST CONGRESS ON THE INFORMATION SYSTEM SCIENCES. SESSION-12. PROGRAMMING INFORMATION PROCESSING AUTOMATA
Mitre Corp., Bedford, Mass., Rept. no. MITRE SS12, ESD TDR63 474 12, Oct. 1963, 67 p., AD 422 475.

The development of large programs is treated as an independent machine and problem programming discipline. . . Programming is presented as the total process of program development . . . The conclusion is reached that hardware and software merge to form a computational entity, and that in the future, hardware and software must be designed concurrently . . .

MILESTONE 7 - TRACKING STATION COMPUTER PROGRAM OPERATING INSTRUCTIONS
System Development Corp., Santa Monica, Calif., 3 May 1963, 40 p., AD 405 392.

. . . required for the operation of the tracking and commanding computer and of the telemetry computer . . .

COMPUTER PROGRAMS
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 23/26.

Satellite Rate Program to ascertain whether the angular velocity and acceleration encountered in a ha-dec antenna tracking an Earth satellite in any given orbit will violate the physical limitations placed on the antenna . . . DSIF Tracking Data Analysis . . . SDS920 computer . . . Benson-Lehner plotter . . . Stereographic Projection Program.

COMPUTER PROGRAMS - TRAJECTORY PROGRAM FOR ON-SITE COMPUTERS
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 13/14.

A spacecraft trajectory program has been developed for small, on-site computers (SDS 920, IBM 1620) to relieve the Central Computing Facility of the responsibility of providing predictions and/or antenna drive tapes for the DSIF stations. Although the program will be kept as small as possible, it will be accurate enough to permit the spacecraft to be within the beamwidth of the antenna pattern.

Related Publications:

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 83/90.

. . . The primary means for entering programs and data into the memory of the stored program controller (SPC) is the paper tape reader.

The manual control panel for the Mod II ranging equipment consists of four push buttons and seven indicators mounted on one 1 3/4 in. panel. Test programs. Ranging acquisition program. . . .

NUMERICAL STUDIES OF A TWO-POINT NON-LINEAR BOUNDARY VALUE PROBLEM USING DYNAMIC PROGRAMMING, INVARIANT IMBEDDING, AND QUASILINEARIZATION
R. E. Bellman, et al., Rand Corp., Santa Monica, Calif., Memo no. RM4069PR, March 1964, p. 97, AD 434 561.

A DIGITAL-COMPUTER CODE FOR THE ANALYSIS OF THERMIONIC NETWORKS
J. H. Broido, et al., General Dynamics Corp., General Atomic Div., San Diego, Calif., May 22, 1963, 77 p., 6 refs., N63-17814.

OUTLINE AND BIBLIOGRAPHY FOR THE 4-WEEK Q-7 CODING COURSE
R. J. Gilinsky, et al., Systems Development Corp., Santa Monica, Calif., TM1118 002 00, 20 March 1963, 10 p., AD 404 724.

DEVELOPMENT OF TECHNIQUES FOR PREDICTION OF SYSTEM EFFECTIVENESS
T. J. Horrigan, Cook Electric Co., Morton Grove, Ill., Final rept., RADC TDC63 407, 28 Feb. 1964, 133 p., AD 432 844.

. . . existing languagues are investigated and found unsuitable because of lack of suitable logic, protracted programming time or lack or unstability by other than specially trained professional programmers. . ...

A GENERALIZED ASSEMBLY SYSTEM
G. H. Mealy, Rand Corp., Santa Monica, Calif., RM-3646-PR, Aug. 1963, 76 p., 11 refs., N63-19931.

A general assembly system (GAS), which combines arbitrary pieces of code and data and allows cross referencing between the various segments, is discussed. . . .

ANALYSIS OF THE DECISION RULES IN DECISION TABLES
S. L. Pollack, Rand Corp., Santa Monica, Calif., Memo. no. RM3669PR, May 1963, 69 p., AD 407 719.

. . . can improve the . . . previous techniques such as flow charting and narrative descriptions of data processing problems . . . produce computer programs that are efficient in the use of computer storage and computer running time . . .

ASSOCIATIVE MEMORY COMPUTERS FROM THE PROGRAMMING POINT OF VIEW
T. Singer, et al., MITRE Corp., Bedford, Mass. Rept. no. W5492, ESD TDR63 245, Aug. 1963, 19 p., AD 416 301

The concept of associative memory is studied . . . likelihood of implementation in the present or near future. The writers examine critically the views of all associative memory investigators known to them. Particular attention is paid to the programming implications of associative memory, and the ideas are tested through a detailed study of three programming problems chosen from widely separated areas . . .

METHODOLOGIES FOR SYSTEM DESIGN
Hughes Dynamics, Los Angeles, Calif., Final rept., 24 Feb. 1964, 101 p., AD 434 749, Appendices to final report, see AD 434 748.

. . . include, (1) . . . formalization of a calculus of operations developed for aiding definition of processes for file organization and searching, (2) the complete programs for an evaluation and assignment model . . . for . . . optimum assignment . . . to points in a hierarchical reporting structure . . .

Section 3A.16
Computer Operation

3A.162: Reliability of Computing Systems

Included: Redundant designs in computer systems; Repairable redundant computers.

Not Included: Reliability theory of electronic systems; Lifetime predictions for space electronics hardware; Environmental influences in space craft electronics.

Cross References: Diagnostic programs (3A.170); Self-repair methods in computing systems (3A.170); Redundant design of computer circuitry (3A.221).

Principal Publications:

A RELIABILITY RECORD
A. P. Hendrickson, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 363/372.

. . . In the Athena Computer was achieved . . . with careful, detailed application of sound engineering and manufacturing practices. . . . The data presented are derived from field failure reports produced by Univac maintenance teams. . . .

INCREASING RELIABILITY BY THE USE OF REDUNDANT MACHINES
D. E. Rosenheim, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 125/130.

The improvement of reliability and availability through redundancy of entire machines rather than of components is investigated. An attempt is made to break down the cost of operating a digital computer, and to determine the relationship between cost and system failure.

IMPROVEMENT OF ELECTRONIC-COMPUTER RELIABILITY THROUGH THE USE OF REDUNDANCY
W. G. Brown, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 407/416.

. . . shows various redundant configurations considered and the conclusion drawn.
From all of the considerations, the majority gate provides a practical method for increasing the reliability. It shows that for operating periods which are short compared to the mean time to failure of the elements, a substantial increase in system reliability is obtained with majority-gate redundancy.

TECHNIQUES FOR ACHIEVING OPERATIONAL RELIABILITY AND MAINTAINABILITY IN DIGITAL COMPUTERS
T. B. Lewis, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 163/181.

TWO APPROACHES TO INCORPORATING REDUNDANCY INTO LOGICAL DESIGN
L. dePian, et al., IN: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 379/388.

. . . two different approaches to the synthesis of logical circuits incorporating redundant functional elements. The principles underlying these two methods are: 1) Statistical averaging; 2) Majority correction.

THE RELIABILITY OF COHERENT SYSTEMS
J. D. Esary, et al., IN: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 57/61.

A general system of notation useful for describing the organization of a wide class of systems with redundancy is presented. Upper and lower bounds on the reliability of these systems are computed by approximating their structure by parallel-series and series-parallel arrangements. The Moore-Shannon inequality is generalized for the case in which system components have different reliabilities.
This work provides a good general foundation for the analysis of redundancy schemes involving something more than simple replication of indentical components.

STATISTICAL THEORY OF IMPROVING THE RELIABILITY OF DIGITAL COMPUTERS WITH REDUNDANCY
E. J. Farrell, IN: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 349/366.

THE DESIGN OF DIGITAL CIRUCITS TO ELIMINATE CATASTROPHIC FAILURES
J. H. Griesmer, R. E. Miller, and J. P. Roth, IN: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 328/348.

. . . describe a reliable digital system designated as the replacement system. . . . has a provision for immediate and automatic repair after a catastrophic failure, which disables a large part of the system. The replacement system employs active redundancy, in which a switching arrangement replaces the faulty part with a spare part from a standby reserve. . . . the authors divide an original system into N functional parts, replicate each part m times, and provide the necessary interconnecting switches and control circuitry.

RESTORATIVE PROCESSES FOR REDUNDANT COMPUTING SYSTEMS
W. C. Mann, IN: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 267/284.

RELIABILITY OF REDUNDANT COMPUTERS
R. Teoste, Lincoln Lab., Mass. Inst. of Tech., Lexington, July 16, 1962, p. 83, 9 refs., N63-19428.

DESIGN OF A REPAIRABLE REDUNDANT COMPUTER
R. Teoste, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 643/649.

. . . using the Von Newmann multiplexing scheme. The general considerations, as well as the reasons for selecting this type of redundancy, are given. A reliablility model of the redundant equipment is presented with resulting curves for estimating the reliability improvement and the additional cost of the redundant equipment.

ATTAINMENT OF COMPUTER RELIABILITY THROUGH LOGICAL ORGANIZATION
J. J. Wedel, Jr., JPL Space Progr. Summ., vol. 4, no. 37-15, April/May 1962, p. 66/67.

COMPUTER RELIABILITY STUDY
D. O. Baechler, et al., Arinc Research Corp., Washington, D. C., Los Angeles, Calif. Space Systems Div., Final Report, 1 July 1962 - 30 June 1963, SSD-TDR-63-150, July 1963, 217 p., AD 413 019, N64-12183.

. . . A measure of performance, which measures computer failures, rather than part failures, is developed . . . Techniques for increasing the reliablility of the computer are incorporated in the design, and the measure of performance developed in the report is used to evaluate and compare the original and modified designs.

COMPUTER RELIABILITY STUDY
Hughes Aircraft Co., Culver City, Calif. Summary tech. rept., Oct. 1962 - Sept. 1963, Rept. no. P63 59, Sept. 1963, p. 219, AD 429 094.

. . . reliability synthesis techniques . . . based upon the unique characteristics of control computers as opposed to those of data processors, and which are realizable with present-day computer construction technology. . . . based on the assumptions that control systems can tolerate some wrong stimulations from the control computer, but cannot tolerate long downtime, and that degradations in computer capability can be tolerated. . . .

Related Publications:

THE ATHENA COMPUTER, A RELIABILITY REPORT
L. W. Reid, et al., Proc. Eastern Joint Computer Conf., Dec. 1958, p. 20/24.

The high performance reliability which has been achieved in the Remington Rand Univac Athena Guidance Computer is discussed. . . . a large-scale general-purpose transistorized digital computer which is part of the Radio Inertial Guidance System for the Titan missile. Three Athena computers have been operated for 6361 hours with only 27 failures.

LIMITING LAW FOR RELIABILITY OF SEQUENTIAL SYSTEMS
B. G. Klimov, Foriegn Tech. Div., Air Force Systems Command, Wright Patterson AFB, Ohio, 16 Aug. 1963, 17 p., AD 420 763.

3A.163: Man-Machine Relationships in Computer Operations

Included: The baseball program; On-line man-computer communication; Man-computer interface; Sketchpad; Graphical communication with computers; Man-computer dialogue.

Cross References: Computer languages (3A.140); Computer programming (3A.150).

Principal Publications:

COMPUTERS — THE KEY TO TOTAL SYSTEMS CONTROL: AN INDUSTRIAL VIEWPOINT
W. M. Carlson, Commun. ACM, vol. 5, March 1962, p. 172/173.

Man-machine processes are surveyed. These processes can be characterized in five main types: communications networks, data processing, control processing, information processes and learning processes. The markets for each type are shown for 1950 and 1960, and estimated for 1970.

THE SYSTEM SYSTEM AND BRIDGES OVER THE GULF BETWEEN MAN-MACHINE-SYSTEM RESEARCH AND MAN-MACHINE-SYSTEM DEVELOPMENT
J. C. R. Licklider, Bolt, Beranek and Newman, Inc., Cambridge, Mass., Jan 1962, 30 p., AD 424 284.

The need for greater coherence in the man-machine and other high-order interactions of our major systems is described, and an approach to achievement of that coherence is proposed. The approach involves a computer-centered meta-system (the "system system") designed to facilitate communication, coordination, and problem-solving. . . .

INFORMATION TRANSFER BETWEEN MEN AND COMPUTERS
A. Debons, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 377/388.

PROBABILISTIC INFORMATION PROCESSING BY MEN, MACHINES, AND MAN-MACHINES SYSTEMS
W. Edwards, System Development Corp., Santa Monica, Calif., Rept. no. TM1418 000 01, 13 Aug. 1963, 9 p., AD 428 727.

A discussion is presented of the argument that Bayes's theorem is a normative model for inductive inference. Results of several experiments are presented that indicate that human beings do not behave the way this normative model says they should; the implications of these ideas and findings suggest the design of information processing systems intended for business, military, or governmental use. Research in progress on such systems is described.

MANUAL COMPUTER INPUTING EXPERIMENTS
G. G. Gildner, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 254/256.

. . . experiment reported here was undertaken to collect empirical data establishing human performance as a function of number of response alternatives and response mechanism. . . .

CODING AND USE OF INFORMATION IN PROBLEM SOLVING
M. Glanzer, Maryland U., College Park, Final rept., Sept. 1958 - Aug. 1963, 10 Feb. 1964, 15 p., AD 430 244.

. . . Work is described on the areas of problem solving, encoding of perceptual information, and learning and storage of verbal materials.

MAN-COMPUTER INTERFACE STUDY
D. L. Johnson, et al., Washington U., Seattle, Coll. of Engineering, June 1963, 155 p., AD 416 612, AD 428 649.

Part I . . . a method for problem solving and learning related to trigonometry problems . . . Part II . . . research in computer game playing . . . relationships between various existant computer-chess approaches and the one developed by this research . . . Part III . . . human attitudes toward the man-machine relationship.

SKETCHPAD III, THREE DIMENSIONAL GRAPHICAL COMMUNICATION WITH A DIGITAL COMPUTER
T. E. Johnson, Electronic Systems Lab., Mass. Inst. of Tech., Cambridge, May 1963, 51 p., AD 406 855.

. . . effective graphical man-machine communication . . . it is desired that the human designer at the computer console be able to quickly construct and manipulate three-dimensional figures in as natural a manner as possible, at the same time making use of the logical and computational power of the computer to assist him. . . .

AN EXPERIMENTAL DEMONSTRATION OF IMPROVED MAN-MACHINE DIALOGUE IN THE SAGE SYSTEM
H. Sackman, System Development Corp., Santa Monica, Calif., Technical memo. no. TM-930/000/01, Feb. 1963, 71 p., AD 299 556.

EXPERIMENTAL STUDIES IN MAN-COMPUTER DIALOGUE
H. Sackman, System Development Corp., Santa Monica, Calif., Rept. no. SP1486 000 01, 14 Feb. 1964, 111 p., AD 437 774.

. . . emergence of applied man-machine digital systems. . . . reviews the SAGE system with special emphasis on the man-computer interface and describes three experimental studies in SAGE man-computer dialogue. . . . emergence of a pragmatic testing philosophy . . .

SKETCHPAD: A MAN-MACHINE GRAPHICAL COMMUNICATION SYSTEM
I. E. Sutherland, Lincoln Lab., Mass. Inst. of Tech., Lexington, AFESD TDR63 52, 30 June 1963, 92 p., AD 404 549.

. . . system contains input, output, and computation programs that enable it to interpret information drawn directly on a computer display. . . .

COMPUTER GENERATION OF WORD ASSOCIATION MAPS FOR MAN-MACHINE COMMUNICATION
C. Watson, System Development Corp., Santa Monica, Calif., 25 March 1963, 24 p., AD 402 647.

THE BASEBALL PROGRAM: AN AUTOMATIC QUESTION-ANSWERER. VOLUME I
A. K. Wolf, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 306, ESD TDR 63 586, 11 April 1963, 209 p., AD 432 038.

. . . answers questions posed in ordinary English about baseball data stored in the computer . . . combined linguistic analysis with data retrieval and processing.

FIRST CONGRESS ON THE INFORMATION SYSTEM SCIENCES. SESSION 4. JOINT MAN-COMPUTER DECISION PROCESSES
MITRE Corp., Bedford, Mass., Rept. no. SS4 ESD TDR 63 474 4, Feb. 1964, 118 p., AD 432 169.

. . . involves choosing one of a number of alternatives after simultaneously evaluating the human-generated inputs to machines are . . . limited. . . . A number of devices, software, and language forms are described.

Related Publications:

USE OF SEMANTIC STRUCTURE IN INFORMATION SYSTEMS
J. D. Sable, Commun. ACM, vol. 5, Jan. 1962, p. 40/43.

Semi-automatic techniques for semantic analysis and the use of semantic structure for information retrieval are described.

ADVANCED LANGUAGE PROCESSING PROCEDURES
J. Keyser, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 391/398.

. . . The problem is: How does one impart to a computer based system the ability to be questioned in ordinary English?

ADVANCED LANGUAGE PROCESSING PROCEDURES
S. J. Keyser, Electronic Systems Div., Bedford, Mass., ESD-TDR-63-620, Sept. 1963, 24 p., refs., AD 430 608, N64-16825.

. . . to outline a recent theoretical advance in the science of linguistics that renders possible the use of natural English as a query language in computer-based systems . . .
several characteristics which distinguish the alternatives. . . . results of experiments conducted with human subjects to determine how decision-making performance varies with the number of characteristics presented in a complex decision problem. . . .

FIRST CONGRESS ON THE INFORMATION SYSTEM SCIENCES. SESSION 5. MAN-COMPUTER INFORMATION TRANSFER
Mitre Corp., Bedford, Mass., Rept. no. MITRE SS5, ESD TDR 63 474 5, 27 p., AD 428 931.

. . . a need and place for wider range of direct graphical input devices and languages. . . .

Section 3A. 17

3A. 170: Computer Maintenance

Included: COSMOS utility system; Supervisory routines; Diagnostic monitor systems; Monitoring programs; Fault-locating methods in computing systems; Automated maintenance; Diagnostic maintenance.

Not Included: Code for automatic repair methods (2).

Cross References: Computer programming (3A.150).

Principal Publications:

A CONTROL SYSTEM FOR LOGICAL BLOCK DIAGNOSIS WITH DATA LOADING
M. E. Senko, Commun. Assoc. Computing Mach., vol. 3, April 1960, p. 236/240.

A section of an integrated diagnostic moniter system which facilitates the checking of sections of instructions or subroutines anywhere in the object program is described. A new method of specifying all diagnostic operations in a format similar to a computer program makes the system convenient to use and relatively simple to understand.

USING DIGITAL COMPUTERS IN THE DESIGN AND MAINTENANCE OF NEW COMPUTERS
A. L. Leiner, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 680/690.

A FLEXIBLE AND INEXPENSIVE METHOD OF MONITORING PROGRAM EXECUTION IN A DIGITAL COMPUTER
F. F. Tsui, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 253/259.

. . . The monitoring method is flexible and convenient in its application. It can be used in connection with relative or symbolic addresses, compilers, etc. The user must provide only a flow diagram drawn on translucent paper in a certain form and the information to correlate this diagram with the computing program.

STATISTICAL CONSIDERATIONS IN ELEMENT VALUE SOLUTIONS
R. S. Berkowitz, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 282/288.

. . . The method presented is an iteration one using maximum likelihood estimation techniques at each stage, the iteration accounting for the nonlinearity of equations used with respect to the element value unknowns.

AN APPLICATION OF INVERSE PROBABILITY TO FAULT ISOLATION
F. D. Brown, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 260/267.

. . . by an analysis of failure symptoms. Prior to performing fault isolation, the performance of a network with respect to possible failures is established. . . . the procedure for isolating a fault is presented in terms of extracting a "signal" from random amplitude "noise." . . .

AN AUTOMATIC SELF-CHECKING AND FAULT-LOCATING METHOD
F. Lee, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 649/654.

. . . designing systems which automatically check themselves and give indications by which internal faults can be located quickly and accurately. Relatively little circuitry is required, and the performance of the test and fault location are easy. The proposed method entails the arrangement of a sequence of events which can be completed properly only if no malfunction exists.

A PROGRAMMING SYSTEM FOR DETECTION AND DIAGNOSIS OF MACHINE MALFUNCTIONS
T. R. Bashkow, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 1, Feb. 1963, p. 10/17.

. . . This paper describes in some detail a program which detects and logs machine errors and then transfers to a diagnostic section to locate the error. A sample of the diagnostic program is given to illustrate the technique that is used.

A TIME-SHARING DEBUGGING SYSTEM FOR A SMALL COMPUTER
S. Boilen, et al., Proc. Spring Joint Comp. Conf., May 1963, p. 51/57.

A system for on-line miltiple access to a computer with multi-programming capabilities is described in this paper. Up to five users, each provided with his own typewriter, can use the computer for debugging programs and other purposes.

The basis of the system is a memory swap in which 4096 words are transferred from memory core to one of 22 fields of a high speed magnetic drum memory and simultaneously the core is loaded from a different drum field. . . .

ON THE DEVELOPMENT OF A SUPERVISORY SEQUENCING ROUTINE
M. H. Gotterer, IEEE Trans. Commun. Electronics, no. 67, July 1963, p. 383/388.

. . . This paper describes a self-scheduling routine which can be incorporated into the supervisory system of a computer. The problem of scheduling a number of tasks on an overloaded computer can be formulated as a linear programming problem and then solved by means of the transportation method. Priorities for both jobs and customers, as well as a nonlinear loss function for late completion, form the basis of the model.

SELF-TEST OF DIGITAL EVALUATION EQUIPMENT
M. C. Kidd, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1283/1296.

Digital Evaluation Equipment (DEE) is a programmer-controlled concept for building block test equipment. A particular system consists of a computer/controller, measuring system, stimulus generators and power supplies. DEE self-test utilizes a dual function concept; (1) automatically programmed testing, and (2) individual self-test of each building block. . . .

DIAGNOSTIC MAINTENANCE: A TECHNIQUE USING A COMPUTER
W. R. McCormack, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 931/941.

A COMPUTER ORGANIZATION AND PROGRAMMING SYSTEM FOR AUTOMATED MAINTENANCE
K. Maling, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 887/895.

. . . an approach to the maintenance problem of central processors which minimizes the human role. This approach consists of a combination of 1) a programming system which computes the diagnostic program from the design-automation tape, and 2) a novel organization of a part of the controls of an experimental computer.

COSMOS IV MANUAL
System Development Corp., Santa Monica, Calif., Rept. no. TM LX 81 001 00, 15 Oct. 1963, lv., AD 435 149.

COSMOS (Colorado Springs Maintenance and Operating System) is a utility system for the Philco 212 developed by SDC in support of the production and testing of the 425L (NORAD COC) Operational System and support systems. It contains large portions of the Philco SYS System, a JOVIAL Compiler, and special-purpose programs used in the production and testing of program systems. . . .

Related Publications:

DETECTION AND CORRECTION OF FAILURES IN DIGITAL ARITHMETIC UNITS
A. A. Avizienis, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 21/24.

The results of an investigation of redundancy in guidance computers . . . led to the choice of product coding of binary numbers to implement the detection of arithmetical and transmission errors. The properties of product codes and arithmetical algorithms for product-coded numbers are discussed in this summary.

THE CARRY-DEPENDENT SUM ADDER
M. Y. Hsiao, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 265/268.

. . . a checking scheme called "carry-dependent sum add" which is based on the parity prediction method. This scheme assures single-fault detection without duplication of the carry circuit. An example of a binary adder and a decimal adder using this scheme are included.

Section 3A. 18: Use of Computers

3A. 182: Special Machine Computation Problems

Included: Computing special functions; Tables of numerical values; Machine solutions of aerospace problems.

Not Included: Random processes in communications (1).

Cross References: Special numerical computation methods (3A. 116).

Principal Publications:

A NOVEL TYPE OF ISOGRAPH (Algebraic Equation Solver)
P. V. Rao, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 97/103.

. . . Development, design, and construction of an inexpensive and portable isograph which is capable of locating the roots of a polynomial with fairly high accuracy. This isograph can serve as a valuable aid to large-scale computing machinery, for which the roots of a polynomial must be isolated before further calculations can be performed.

THE USE OF A REPETITIVE DIFFERENTIAL ANALYZER FOR FINDING ROOTS OF POLYNOMIAL EQUATIONS
P. Madich, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 182/185.

. . . describes a procedure for obtaining real and complex roots of algebraic equations with real or complex coefficients by the use of a repetitive differential analyzer. The procedure requires only operational amplifiers and ganged linear potentiometers. . . . The procedure is not iterative.

TECHNIQUES FOR COMBINATORIAL COMPUTATION
P. N. Armstrong, et al., Packard-Bell Electronics Corp., Los Angeles, Calif., Final report., Rept. no. PBC 4127, RADC TDR 62-340, 22 May 1962, 108 p., AD 298 624.

SOLUTION OF NONLINEAR INTEGRAL EQUATIONS USING ON-LINE COMPUTER CONTROL
G. J. Culler, et al., Proc. A FIPS Spring Joint Computer Conf., May 1962, p. 129/138.

. . . paper deals with the application of the on-line computation techniques to the solution of a certain nonlinear integral equation which occurs in the Bardeen-Cooper-Schrieffer theory of superconductivity.

PARAMETRIC TECHNIQUES FOR ELIMINATING DIVISION AND TREATING SINGULARITIES IN COMPUTER SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS
A. Hausner, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 42/45.

By using the analog-computer independent variable time, as a parameter, a differential equation can be transformed into a set of first-order equations containing no divisions. This makes it possible, by means of other mathematical transformations to prevent unbounded functions from occurring during a computation and sometimes to continue solutions through singularities.

PROGRAMMED COMPONENT INSERTION MACHINES ASSEMBLE COMPUTER LOGIC CARDS
A. H. Johnson, Control Engrg., vol. 9, Jan. 1962, p. 61/63.

ANALOG COMPUTATION OF GREEN'S FUNCTION FOR INTEGRATING TWO-POINT BOUNDARY VALUE PROBLEMS
R. M. Terasaki, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 57/63.

A COMPUTER METHOD FOR CALCULATION OF THE COMPLETE AND INCOMPLETE ELLIPTIC INTEGRALS OF THE THIRD KIND
D. K. Ai, et al., Hydrodynamics Lab., Calif. Inst. of Tech., Pasadena, Rept. no. E110 3, Feb. 1964, 34 p., AD 437 207.

TABLES OF BOUNDS FOR DISTRIBUTIONS WITH MONOTONE HAZARD RATE
R. E. Barlow, et al., Boeing Scientific Research Labs., Seattle, Wash., Document no. D1 82 0249; Mathematical note no. 294, Dec. 1963, 54 p., AD 426 831.

. . . presented in a form convenient for applications . . . machine calculation has been necessary . . . Applications of the bounds are discussed together with some numerical examples . . .

LENS DESIGNING WITH THE 1962 LASL CODE FOR THE IBM 7090
B. Brixner, Los Alamos Scientific Lab., N. Mex., LA-2877, 5 June 1963, 46 p., 8 refs., N63-17947.

TABLE OF BINOMIAL COEFFICIENTS
C. H. Burton, et al., General Electric Co., Oklahoma City, Okla., Military Communications Dept. rept. 63MCD6, April 4, 1963, 102 p., N63-22326.

. . . are presented for values of N from 1 to 100 and all possible values of 1. The tables were computed by constructing successive rows of Pascal's triangle on the IBM 1620 Computer.

AUTOMATIC COMPUTATION OF TAYLOR'S SERIES WHICH ARE POWERS OF TAYLOR'S SERIES
T. J. Cappellucci, Texas A. and M. Coll., College Station, Aug. 1963, 56 p., AD 414 751.

. . . automatic computational procedures as performed on the IBM 709 digital computer. No attempt is made to review critically the relative merits of the machine methods.

STATISTICAL INSTRUMENTATION STUDY (Final Report)
A. W. Crooke, et al., Litton Systems, Inc., Data Systems Div., Waltham, Mass., RADC-TDR-63-136, March 14, 1963, 93 p., 11 refs., N63-17118.

The choice between parallel processing of samples utilizing a general purpose computer and serial processing with a special purpose device hinges on (1) the availability of a computer (2) the capability to feed data directly into the computer without intermediate storage, and (3) whether many small-scale probability analysis will be performed, or relatively few large-scale analyses. . . .

NUMERICAL SOLUTIONS OF LINEAR INTEGRAL EQUATIONS USING ON-LINE COMPUTATION
F. Dion, RADC, Griffiss AFB, N. Y., Information Processing Lab., RADC-TDR-63-307, July 1963, 17 p., 9 refs., N63-19881.

. . . generalized numerical methods for solving a large class of Fredholm integral equations of the first kind. . . . The methods have been developed for implementation on a digital computer, programed to operate as an on-line computation system.

EFFECT OF THE SUN UPON ANTENNA TEMPERATURE
A. R. Giddis, Philco Corp., Palo Alto, Calif., TR E320, March 1963, lv., AD 410 218.

. . . spatial and spectral properties of solar radio noise are described . . . The method by which antenna temperature is evaluated, using the Philco 2000 computer, is discussed. . . . In addition, the effect of the earth's atmosphere and ground on the total noise temperature is determined. This result are used to calculate the variation of carrier-to-noise ratio as an antenna scans toward the sun while receiving signals from a deep-space probe and from a random-orbit satellite.

A SYSTEM FOR PROGRAMMING EXPERIMENTS AND FOR RECORDING AND ANALYZING DATA AUTOMATICALLY
R. M. Herrick, et al., Aviation Medical Acceleration Lab., Naval Air Development Center, Johnsville, Pa., Rept. no. NADC-MA-6302, 20 Feb. 1963, 17 p., AD 299 442.

METHOD FOR THE SOLUTION OF THE ALGEBRAIC EIGEN PROBLEM FOR THE IBM 7074 COMPUTER
W. J. Higby, Iowa State U. of Science and Tech., Ames, Ames Lab, IS-748, Sept. 1963, 27 p., refs., N64-10222.

. . . A technique for the solution of the algebraic eigen problem $Ax = \lambda x$ for large, real symmetric matrices is presented. . . .

THE SPADATS MATHEMATICAL MODEL
C. G. Hilton, Aeronutronic, Newport Beach, Calif., Publ. no. U2202, ESD TDR63 427, 5 Aug. 1963, 45 p., AD 415 001.

. . . to describe the orbital motion of Earth satellites . . .

TWO NOTES ON THE LOGNORMAL DISTRIBUTION
M. Kamins, RAND Corp., Santa Monica, Calif., Memo. RM3781PR, Aug. 1963, 26 p., AD 415 360.

. . . may be helpful to persons engaged in studies concerning either the solution of queueing problems through simulation or the effects of failure characteristics on reliability. One is a very simple but flexible procedure (with an example in the widely used FORTRAN computer language) for generating a series of observations drawn from a lognormally distributed population. . . . The other is an analysis of one feature of the lognormal distribution of times-to-failure . . .

MATHEMATICAL METHODS FOR PROCESSING STATISTICAL DATA: BOOK REVIEW
G. Kil'kishev, et al., Joint Publications Research Service, Washington, D. C., 18338, Trans of #Voprosy Ekonomiki (USSR) 1962, no. 12, p. 114/117, OTS rept. 63-21416, 25 March 1963, 9 p., AD 404 674.

COMPUTER CONSTRUCTION AND EVALUATION OF LONG BURST-ERROR CORRECTING CODES
J. J. Metzner, New York U., Coll. of Engineering, N. Y., Scientific rept. no. 12, AFCRL 63 28, 31 Jan. 1963, 91 p., AD 402 676.

A specific method of programming a digital computer to construct and evaluate codes suitable for use in a burst-error correction decoding scheme . . . Two (100, 50) codes . . . were constructed . . . One is found capable of correcting uniquely all bursts of length 21 or less. . . .

THE BACKWARD RECURRENCE METHOD FOR COMPUTING THE REGULAR BESSEL FUNCTION
T. E. Michels, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TN D-2141, March 1964, 28 p., refs., N64-17724.

THE SOLUTION OF LARGE SYSTEMS OF ALGEBRAIC EQUATIONS
J. M. Pavkovich, Stanford U. School of Humanities and Sciences, Calif., 6 Dec. 1963, 38 p., AD 427 753.

. . . method for solving a system of linear algebraic equations is described . . . implemented on the IBM 7090 at Stanford for equations with complex coefficients . . . basically Gauss's method with partial pivoting . . .

FORMULATION OF ELECTRICAL NETWORK PROBLEMS FOR COMPUTER ANALYSIS
W. J. Schneider, JPL Space Progr. Summ., vol. 4, no. 37-21, April/May 1963, p. 220/223.

In attempting computer studies of networks, whether for the purpose of determining stability criteria or for an elaborate parameter study, an accurate mathematical representation is required. The reference here is to the accuracy with which the equations are compiled rather than to the adequacy of the mathematical model used. This is a difficult task even for circuits of moderate complexity. . . . The purpose of this article is to present a means for generating the required matrix equations with a minimum of effort and, hopefully, with a minimum of errors.

COMPUTATION USING ELECTRONIC COMPUTERS OF THE MINIMUM USABLE FREQUENCIES AND OTHER VALUES OF SHORT-WAVE COMMUNICATION (Translation)
S. G. Shlionskii, et al., Geomagnetism and Aeronomy, vol. 3, no. 4, 1963, p. 275/276, 9 refs., A64-17038.

Derivation of formulas for the dependence of the minimum usable frequency (MUF) and other quantities based on the method proposed by A. N. Kazantseva for computation of field strength, and on data on atmospheric interference presented at the Warsaw meeting of the International Consultative Commission on Radio Communications. The algorithm and the computation program for use with a digital computer are described.

AN OPTIMAL DATA ASSOCIATION PROBLEM IN SURVEILLANCE THEORY
R. W. Sittler, IEEE Trans. Mil. Electronics, vol. MIL-8, no. 2, April 1964, p. 125/139.

. . . The maximum likelihood estimator is given in a form that lends itself to sequential computations performed in real time as the data arrives. . . . Computer implementations are possible. . . .

PRACTICAL EXPERIENCE WITH POWER SPECTRAL METHODS ON A SMALL DIGITAL COMPUTER
F. Snoodijk, et al., Presented to the Intern. Symp. on Analogue and Digital Tech., appl. to Aeron., Liege, Sept. 9th-12th, 1963, 14 p., N64-10214.

. . . The . . . applying power spectral methods . . . when only a small digital computer is available . . . frequency response functions . . . by firstly calculating the response to a step function input and finally applying the Fourier transform to these responses . . . accuracy of the numerical integration method . . .

THE N-BODY CODE - A GENERAL FORTRAN CODE FOR THE NUMERICAL SOLUTION OF SPACE MECHANICS PROBLEMS ON AN IBM 7090 COMPUTER
W. C. Strack, et al., National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio, NASA TN D-1730, Nov. 1963, 110 p., refs., N64-10174.

DIE VERWENDUNG VON RECHENAUTOMATEN IN DER THEORETISCHEN ASTROPHYSIK (The Use of Computers in Theoretical Astrophysics) (In German)
E. Trefftz, Internationales Kolloquium uber Aktuelle Probleme der Raketentechnik, 2nd, Dresden, Germany, June 1962, Wissenschaftliche Zeitschrift, vol. 12, no. 1, 1963, p. 93/95, A64-17897.

. . . summary of several astrophysical problems which have been investigated with the aid of computers . . . application to determining atomic wave functions and transition probabilities of spectral lines . . . investigations of the theoretical conditions for stellar rotation, measurement of the Zeeman effect in stellar spectra, . . . study of the relationship between magnetic fields and hydrodynamic phenomena.

IONOSPHERIC REFRACTION ERRORS MEASURED IN THE DOPPLER SHIFT OF RADIO TRANSMISSIONS FROM ARTIFICIAL EARTH SATELLITES
J. F. Willman, et al., Defense Research Lab., U. of Texas, Austin, Rept. no. DRL 491, 11 Feb. 1963, lv., AD 415 771.

. . . error analysis of the refraction error digital computation program . . . Synthesized Doppler data with varying amounts of error are processed by the IBM 1620 and the results are shown.

RADIATION PATTERN AND ANTENNA EFFICIENCY COMPUTER STUDIES
JPL Space Progr. Summ., vol. 3, no. 37-23, July 1963, p. 34/38.

Two studies are currently being conducted, using the IBM 7094 computer, to numerically evaluate the scalar far-field radiation pattern integral and aperture efficiency of paraboloid reflector antennas . . .

A METHOD OF REJECTING POSSIBLE BLUNDER POINTS IN TRACKING DATA
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 14/18.

The tracking data used by the Orbit Determination Program (ODP) has a tendency to be contaminated by discrete noise with large variance. This usually happen with very small probability. Because of the nature of the estimation technique used in the ODP, great importance is given to the removal of these points. These points or observations are usually called "blunder points." The optimum time for removing the blunder points is just before the tracking data is used by the ODP; this is the method discussed in this article.

30-FT ANTENNA REFLECTOR CALCULATIONS
JPL Space Progr. Summ., vol. 3, no. 37-25, p. 26/27.

Deformations of reflector structure from gravity loads. The reflector panels of the Goldstone Venus site 30-ft antenna were set to a paraboloidal shape at zenith look using optical tooling means. The change in shape caused by the directional change of gravity force when the reflector was rotated to horizontal look was then measured. This presented an opportunity to check the measured deformations against the computed deflections using the STAIR Computer Program.

Related Publications:

THE COMPUTER AS AN AID TO THE DESIGN AND MANUFACTURE OF SYSTEMS
T. H. Crowley, IEEE Internat. Conv. Rec., Pt. 4, vol. 11, March 1963, p. 47/51.

OPTIMIZATION AND VISUALIZATION OF FUNCTIONS
G. A. McCue, AIAA Journal, vol. 2, Jan. 1964, p. 99/100, A64-13136.

Description of a numerical technique which results in computer-generated contour maps . . . has been employed in the optimization of functions of several variables. It has proved to be an invaluable aid to subsequent exact investigation of a function's extremes by conventional numerical search techniques . . . may be used to generate stereographic views of a mathematical function. . . .

STOCHASTIC PROGRAMMING
S. M. Sinha, California U., Berkeley Operations Res. Center, ORC 63-22-(RR), 19 Aug. 1963, 68 p., N64-10988.

. . . A stochastic programming problem (where the coefficients of the objective function, the constraint inequalities, and the resources are random variables) is approached probabilistically . . . assumption that at least the means, variances, and covariances of the random variables are known . . .

ON THE COMPARISON OF THE MEANS OF TWO POPULATIONS WITH UNKNOWN VARIANCES
Y. Yao, Carnegie Inst. of Tech., Pittsburgh, Pa., Final rept. Sept. 1961 - June 1962, June 1963, 54 p., AD 415 002.

. . . using the method of "Approximate Degrees of Freedom." A modified version of the Welch method is given for the univariate situation, and an extension is given for the general multivariate situation. . . .

DIVISION 3A.2
ENGINEERING OF DATA PROCESSING EQUIPMENT

Data processing equipment or, more specifically, electronic computers, experienced one of the fastest technological developments on record. In less than ten years computer technology advanced from relay circuits over electron tube units to solid state computers. Currently we are in the midst of another technological revolution, moving from transistor circuits with clearly identifiable components to integrated circuits where complete logical units are smaller than the smallest single parts in earlier devices. Development efforts are already being extended beyond the recently introduced integrated circuits to thin film technologies and cryogenic methods.

Hopefully, further cost and size reductions of orders of magnitudes may result from the application of such progressive methods. Such an outlook brings technological dreams of space communications engineers within the range of practical realization. Complexity of circuits will no longer be a deterrent to their application, provided that these novel technologies are actually realized.

The lay-out of this division reflects the transient character of data processing technology. The first and the second sections concentrate on references to reports which summarize various novel technologies. Section 3A.22 deals with the all important logic units. It contains special subdivisions for tunnel diode logic circuits and for parametrons. This section gives, therefore, references to the elementary circuits for digital data processors.

Accordingly, it is followed by a section on the fundamental circuits for analog data processors (3A.23). Subdivisions for operational amplifiers, multipliers, integrators and other functional units are in this section.

Arithmetic units (3A.24), control units (3A.25) with counters and shift registors and memory units (3A.26) provide information about the essential subsystems of computers.

The section on memory units also contains two subdivisions with references to short analog memories; 3A.263 for electron beam storage devices and 3A.265 for relay lines, recirculating memories and similar devices. Mass storage media will be discussed in division 3A.3.

The last section contains two subdivisions on two related engineering problems of interconnections (3A.282) and on error control measures in computers (3A.283).

Section 3A.20: Principal Computer Technologies

3A.200: Components and Materials in Computer Design

Included: Ferri-electrics in computer technology.

Not Included: Special materials for space environment.

Cross References: Magnetic devices in logical units (3A.226); Magnetic cores in memory units (3A.264).

Principal Publications:

BIBLIOGRAPHY OF DIGITAL MAGNETIC CIRCUITS AND MATERIALS
W.L. Morgan, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 148/158.

. . . about 400 references relating to magnetic memory and logic circuits . . . divided into 19 sections . . .

MAGNETICS FOR COMPUTERS — A SURVEY OF THE STATE OF THE ART
J.A. Rajchman, RCA Rev., vol. 20, no. 1, March 1959, p. 92/135, 44 refs.

The present-day applications of magnetics to random-access memories and logic switching are surveyed and appraised. The memory discussion includes core arrays, external addressing, apertured plates, thin films, and twistors. The survey of switching includes combinatorial switches, shift registers, current steering, voltage drives, transistor coupling, parametron, transfluxors, transfluxor current-steering, and multi-apertured transfluxors. . . .

SOME THOUGHTS ON DIGITAL COMPONENTS AND CIRCUIT TECHNIQUES
A.W. Lo, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 416/425.

Signal standardization and control directivity are emphasized as the basic physical requirements in considering components and circuit techniques for the handling of digital information. . . . illustrated by the operations of the parametric phase-locked oscillator and the tunnel diode. . . . to offer a unified viewpoint on digital components and circuit techniques in connection with present-day practice and prospective future development.

UNIVAC-LARC HIGH-SPEED CIRCUITRY: CASE HISTORY IN CIRCUIT OPTIMIZATION
N.W. Prywest, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 426/438.

INVESTIGATION IN DIGITAL TECHNOLOGY RESEARCH
M. Aoki, et al., California U., Los Angeles, Annual summary rept., 1 June 1961-31 May 1962, Jan. 1963, 171 p., AD 404 016.

Organization and command structure for content-addressable memory systems; Assignment problems; Pattern recognition; General discussion and review of automatic pattern recognition . . .

RESEARCH ON VARIOUS PHENOMENA FOR THE PERFORMANCE OF COMPUTER FUNCTIONS: AN ANNOTATED BIBLIOGRAPHY OF REPORT LITERATURE
G.R. Evans, Lockheed Aircraft Corp., Sunnyvale, Calif., May 1963, 73 p., AD 405 748.

. . . research and development studies of various physical phenomena which might be used as the basis of new switching and storage devices. Both solid state and vacuum systems are considered.

FERRIELECTRICS AND THEIR APPLICATION IN SOLID-STATE DEVICES AS AN ADAPTIVE CONTROL
C.F. Pulvari, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 254/260.

The basic properties of the recently discovered ferrielectrics, which are essentially degenerate antiferroelectrics exhibiting ferroelectric properties, will be discussed. . . . A new device which operates similar to the transfluxor and represents an electrostatically controlled circuit impedance with stored settings will be discussed. This device called the "transpolarizer" represents one of the most interesting recent achievements in the semiconductor field. . . . by the application of a control signal, it can be changed from a ferroelectric capacitor into a linear capacitor and can assume any intermediate polarization level between these two limits . . . Now, for the first time, it is possible to utilize the combination of electrically controlled resistance, inductance and capacitance to circuit design. . . . extremely useful in the fields of pattern recognition, trainable computers and adaptive control. . . .

RESEARCH ON AUTOMATIC COMPUTER ELECTRONICS. VOL. I. COMPUTER DEVICE AND CIRCUIT RESEARCH
R.I. Tanaka, Lockheed Missiles and Space Co., Palo Alto, Calif., Final rept. for 1 Sept. 1962-1 Oct. 1963, RTD TDR63 4173, vol. 1, Feb. 1964, 345 p., AD 435 760.

. . . one of three volumes describing results of a 13-month applied research program called RACE . . . Experiments in the solid-state physics . . . resulted in logic element, the design of a ternary threshold element, a cryogenic ternary storage element, the design of a memory array using ternary storage elements, and the design of a variable gain threshold element. . . . work on ferrite logic . . .

3A.201: Engineering for Extreme Environmental Conditions

Included: Low temperature computing elements; Radiation resistive computer design.

Not Included: Thermal design in general; Radiation hardening of space electronics equipment.

Cross References: Design of spaceborne data processors (Div. 3A.8); Reliability of data processing equipment (3A.162).

Principal Publications:

RESEARCH ON LOW TEMPERATURE COMPUTING ELEMENTS
Space Technology Labs., Inc., Redondo Beach, Calif., Annual summary rept., 30 Sept. 1961-30 Sept. 1962, Rept. no. 8971, 95 p., AD 411 546.

ASTRONAVIGATION COMPUTER RESEARCH
J.J. Spirito, Wright-Patterson AFB, Ohio, AF Avionics Lab., Final Report, 4 April 1961-23 May 1963, ASD-TDR-63-337, Oct. 1963, 135 p., AD 423 704, N64-13626.

A biaperture ferrite element has been developed for use in memories and registers in the temperature range from -55° C to +125° C . . . This technique results in high reliability (low number of drivers) and low power consumption . . .

STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS
International Business Machines, Owego, N.Y., Quarterly progress rept. no. 10, Final, 1 Oct. 1962-31 Jan. 1963, 31 Jan. 1963, 59 p., AD 404 493.

Transient radiation effects in magnetic devices and solid tantalum-oxide capacitors are discussed. . . . concluded that the effects on magnetic devices tested are negligible for all practical purposes.

TIMM DATA STORAGE SYSTEM
General Electric Co., Philadelphia, Pa., Feb. 1964, 174 p., AD 432 413.

. . . extremely insensitive to nuclear radiation of relatively high levels. It is based upon the use of TIMM (thermionic integrated micro-module) components in electronic circuits . . . The radiation hardening techniques are also described.

3A.202: Older Technologies

Included: Vacuum tube computer circuits; Relay computers; Historical references to computer technology.

Not Included: Mechanical commutators and counters.

Cross References: General references to data processing publications (3A.000); Computer technology reviews (3A.001).

Principal Publications:

VACUUM VALVES IN PULSE TECHNIQUE (2nd ed.)
P.A. Neeteson, New York, The MacMillan Co., 1959, 190 p.

This relatively short British book has more of the characteristics of a monograph on certain basic types of multivibrator circuits than of a general textbook on pulse circuits using vacuum tubes. The second edition differs from the first primarily by the addition of a 24-page chapter on blocking-oscillator circuits.

RELAY ESSENTIAL HAZARDS (Correspondence)
M.P. Marcus, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 405/407.

It has been supposed that essential hazards to not arise in relay circuits because the secondary response times are large compared with delays in the propagation of primary changes. Essential hazards can arise in relay circuits, however, because of the break-before-make or make-before-break contact characteristics. . . . occurrence has been discovered with commercially available relays.

3A.203: Technologies with Individual Solid State Components

Included: Transistorized printed circuits in data processing; Solid state logic building blocks; Digital modules; Circuit packaging models.

Not Included: Packaging techniques for space electronics.

Cross References: Solid state logic units (3A.223); Microelectronic building blocks (3A.204).

Principal Publications:

A NEW TECHNIQUE FOR COMPUTER SWITCHING
C.M. Campbell, Jr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 211/214.

Because of the wide variety of requirements for military computers (size, environment, speed, etc.), many different switching circuitry techniques have come into use, each best suited to a certain combination of factors. This paper deals with a circuitry technique which is quite advantageous under certain condtions. These . . . are: small physical size for the overall computer, medium frequency rates . . . low cost, and high reliability. . . . The characteristics of the techniques . . . are . . . relatively few components (especially transistors) are required . . . all transistors are either OFF or saturated; transistor dissipation is always small . . . transient response does not deteriorate with increased temperature. Thus, the computer can maintain a fairly high frequency over the entire temperature range. . . .

USING INDUCTIVE CONTROL IN COMPUTER CIRCUITS
W.M. Carey, Electronics, vol. 32, Sept. 1959, p. 31/33.

Transistorized digital computer time-measuring circuits which utilize inductance as the passive time-measuring or storage element are discussed. The circuits include a differentiator, a single-shot multivibrator which provides output pulses longer in duration than the input trigger, a self-starting choke-controlled free-running multivibrator, a transformer-controlled free-running multivibrator, a counter circuit which uses conventional linear transformers instead of the usual square hysteresis loop core, and a shift register.

DESIGN OF TRANSISTORIZED CIRCUITS FOR DIGITAL COMPUTERS
A.I. Pressman, New York, John F. Rider, Inc., 1959, 316 p.

. . . Use of semiconductors in digital computer logic circuits . . . little appears in available books on the detailed design of such circuits. . . . book gives . . . by far the most comprehensive coverage on this subject to date.

A RANGE OF TRANSISTORIZED PRINTED CIRCUITS FOR HIGH SPEED DIGITAL DATA PROCESSING
G. L. Reyns, SHAPE Air Defense Technical Center, The Hague, Netherlands, SADTC TR 1961 R4, Feb. 1961, 61 p., AD 414 733.

. . . required in the study of automatic and integrated control and reporting systems . . . The design aims were to achieve reasonably high switching speeds (of the order of 0.1 millisecond) and very high reliability at reasonable cost. . . .

NCR 315 CURRENT MODE DIODE LOGIC BUILDING BLOCKS
G.H. Goldstick, et al., IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 4/35.

. . . The logic of the NCR-315 Data processing System is mechanized with two-level, current switching, negative, and-or gates, and saturated transistor inverting amplifiers. A schematic of the logical block is presented . . .

A CIRCUIT PACKAGING MODEL FOR HIGH-SPEED COMPUTER TECHNOLOGY
F.K. Buelow, et al., IBM J. Res. Developm., vol. 7, July 1963, p. 182/189, A63-20707.

. . . An Arithmetic and Logic Unit capable of processing 64-bit words in floating-point format has been fully designed. From this design a nucleus system comprising 424 circuits and 1,838 transistors has been abstracted, built, and tested. It is indicated that, in this model, a delay of 2.2 nanosec per level of logic has been achieved in worst-case paths. This figure includes the wiring and power driver delays.

EVALUATION OF COMPUTER CONTROL COMPANY'S H-PAC DIGITAL MODULES
O.E. Gooding, Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Rept. no., CF3024, 22 April 1963, 16 p., AD 418 673.

Descriptors: Computer logic . . . Computer storage devices . . . Packaged circuits . . . Delay circuits.

SPOTLIGHT ON THE STATE OF THE ART-DIGITAL LOGIC MODULES
Data Systems Engineering, vol. 18, Oct. 1963, p. 23/30, A64-11599.

. . . Presented is a list of 265 manufacturers of digital logic modules. Thirteen basic constructions employed in the manufacture of digital logic modules are described, as are the basic circuit functions available in digital logic modules. . . .

3A.204: Technologies with Integrated Circuits

Included: Microminiaturized computer circuitry; Negative-resistance elements in integrated circuits; Solid state microelectronics in data processors; Micro-logic building blocks.

Not Included: Microelectronics in general.

Cross References: Magnetic thin film technology (3A.205); Cryogenic technology (3A.206); Tunnel diode logic circuitry (3A.224).

Principal Publications:

MICROMINIATURE ELECTRONIC CIRCUITRY FOR SPACE GUIDANCE
E. Keonjian, IRE WESCON Conv. Rec., no. 6, 1959, p. 92/99.

The results of a feasibility study of microcircuitry as applied to one part of a space guidance digital computer is described. A full adder consisting of seventeen individual circuits has been built within a total volume of 0.5 cubic inch as one phase of this study.

NEGATIVE-RESISTANCE ELEMENTS AS DIGITAL COMPUTER COMPONENTS
M.H. Lewin, Proc. Eastern Joint Computer Conf., Dec. 1959, p. 15/27.

The qualitative description of various tunnel diode circuits such as threshold gates and inverters are adequate for the purpose of introducing a new device and some of its possible modes of operation.

MICROLOGIC SYSTEM DESIGN CONSIDERATIONS
R.C. Anderson, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 239/245.

Fairchild Semiconductor is in volume production of a set of integrated digital circuits. These circuits, called Micrologic elements, comprise a set of compatible digital building blocks that operate at system bit rates in excess of 1 mc . . .

MICROELECTRONIC, MICROPOWER ANALOG AND DIGITAL CIRCUIT-FUNCTION BLOCKS FOR SPACE APPLICATIONS
W.W. Gaertner, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 8.1, Oct. 1962.

. . . typical examples of microelectronic function blocks . . . based on the concept that each electronic function should be performed at the lowest possible supply power level . . . fabrication is achieved by a technology which completely integrates semiconductor diffusion, alloying and surface passivation processes with thin film deposition of passive components and interconnections in and on the same silicon wafer. . . . design . . . of a digital record circuit for spaceborne multiple-track magnetic tape recorders, an amplifier stage consuming 10 microwatts of supply power, a counter stage . . . and a shift register . . .

A SURVEY AND ANALYSIS OF AIRBORNE ELECTRONIC SUBSYSTEMS AND CIRCUITS FOR MOLECULAR ELECTRONICS
W. Metzger, Melpar, Inc., Falls Church, Va., Rept. for June-Dec. 1960, March 1962, 241 p., incl. illus. tables, AD 275 285.

A detailed analysis was conducted of Air Force weapons systems, of their principal electronic subsystems and equipments, and of the circuits in a major statistical sample of these equipments. . . . (1) to establish guidelines for future Air Force molecular electronics development . . .

SOLID STATE MICROELECTRONIC SYSTEMS PROGRAM
R. Warr, et al., General Electric Co., Syracuse, N.Y., Quarterly rept. no. 2, 1 Oct. 1961-1 Jan. 1962, 1 Jan. 1962, 98 p., incl. illus., AD 274 003.

. . . minimum power dissipation design of the DCTL-NOR circuit . . . Flip-flop circuits of the base return type were synthesized for different values of tolerance . . .

MICROMINIATURIZED LOGIC CIRCUITS: THEIR CHARACTERIZATION, ANALYSIS AND IMPACT UPON COMPUTER DESIGN
J.A. Narud, et al., IEEE Internat. Conv. Rec., Pt. 2, vol. 11, March 1963, p. 178/192.

ADVANCED IN MICROMINIATURIZATION
M.F. Wolff, Electronics, vol. 36, Feb. 15, 1963, p. 45/60, 24 refs., A63-13628.

Review of the state-of-the-art of microminiaturization, including procedures, design problems, and future prospects. Covered are component, thin-film, and semiconductor integrated circuits, and hybrid circuits. . . . Applications of semiconductor integrated circuits include introduction into several aerospace digital computers, plans for inertial navigation systems under design, and programs planning incorporation of these circuits such as the Apollo guidance computer, EGO and POGO satellite digital-data signal conditioners, and an all-weather naval avionics system for helicopters and VTOL aircraft. . . . An outline of possible future trends includes active thin-film and homogeneous devices.

Related Publications:

HIGH-SPEED LOGIC CIRCUITS USING TUNNEL DIODES
R.H. Bergman, et al., RCA Rev., vol. 23, no. 2, June 1962, p. 152/186.

. . . a set of logically complete, general purpose tunnel-diode-tunnel-rectifier logic circuits. Emphasis has been placed on high speed, reliability, and a design for use in large-scale computers. The circuits are d-c powered and do not require a high-powered clock source . . .

RESEARCH ON THE APPLICATION OF FERRO- AND FERRIELECTRIC PHENOMENA IN COMPUTER DEVICES
C.F. Pulvari, Catholic Univ. of America, Washington, D.C., Oct. 1963, 43 p., AD 423 782.

The discovery of the AB03 type or perovskite type ferrielectrics exhibiting a threshold switching field and the valuable results gained during the first phase of this investigation permitted the extension of work to find new materials exhibiting similar properties. This led to the discovery of a second class of ferrielectrics, the MBO type or Mixed Bismuth Oxides type ferrielectrics . . . capacitor elements composed of ferrielectrics of the MBO type employed as dielectric represent an important improvement as compared to ordinary ferroelectic capacitors . . . can be utilized as a computer logic device . . . Ferriresonance flip-flop devices and a shift register using these flip-flops are also presented. . . .

3A.205: Magnetic Thin Film Technology

Included: Evaporated films in digital computers; Thin magnetic film inductors.

Not Included: Production processes for thin film technology.

Cross References: Thin film memories (3A.267); All-magnetic logic circuits (3A.226).

Principal Publications:

AN APPROACH TO MICROMINIATURE PRINTED SYSTEMS
D. A. Buck, et al., Proc. Eastern Joint Computer Conf., Dec. 1958, p. 55/59.

A technique for producing microminiature printed circuit conductors which are 0.1 micron wide is described. Such a technique permits the fabrication of microminiature circuits with a component density of 50 million per square inch per layer. . . .

DEPOSITED MAGNETIC FILMS AS LOGIC ELEMENTS
A. Franck, et al., Proc. Eastern Joint Computer Conf., Dec. 1959, p. 28/37.

This paper discusses some methods of using thin magnetic films to perform logic. The authors describe two modes of operation which result in logical gating. In the "reversible rotation mode" two perpendicular fields influence the film and an output occurs only when both fields are present. In the "saturable transformer mode" the input fields are parallel and an output occurs whenever the net field exceeds a threshold field.

EVAPORATED FILMS AND DIGITAL COMPUTERS
D. W. Moore, IRE WESCON Conv. Rec., no. 4, 1959, p. 32/39.

The use of evaporated conductive, dielectric, and magnetic films in the construction of digital computer circuitry is discussed.

MICROELECTRONIC, MICROPOWER ANALOG AND DIGITAL CIRCUIT-FUNCTION BLOCKS FOR SPACE APPLICATIONS
W. W. Gaertner, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 8.1, Oct. 1962.

. . . typical examples of microelectronic function blocks . . . based on the concept that each electronic function should be performed at the lowest possible supply power level. . . fabrication is achieved by a technology which completely integrates semiconductor diffusion, alloying and surface passivation processes with thin film deposition of passive components and interconnections in and on the same silicon wafer. . . . design. . . of a digital record circuit for spaceborne multiple-track magnetic tape recorders, an amplifier stage consuming 10 microwatts of supply power, a counter stage. . . and a shift register. . .

MAGNETIC-FILM RODS PROVIDE HIGH-SPEED MEMORY
D. A. Meier, Electronics, vol. 35, Feb. 1962, p. 50/52.

High speed memories using cylindrical thin film elements are described. A thin film . . . is electrodeposited over a conductive substrate. The cylindrical shape permits tight coupling and facilitates multiple-term windings that provide large uniform switching fields with reasonable currents.

RESEARCH ON LOW-POWER MAGNETIC-FILM MEMORIES
T. J. Matcovich, Remington Rand Univac Div., Sperry Rand Corp., Philadelphia, Pa., Interim engineering rept. no. 1, 14 May-14 Aug. 1963, 14 Aug. 1963, 25 p., AD 415 438.

. . . feasibility of fabricating microminiaturized evaporated circuitry for use with the low-power magnetic-film memory elements. The layout of a 64-word, 24-bit-per-word memory system, complete with address registers and timing circuits, was completed.

A DYNAMIC LARGE SIGNAL MODEL FOR A SINGLE-DOMAIN THIN MAGNETIC FILM INDUCTOR
A. A. Read, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 517/521.

A dynamic large signal model for a thin film inductor consisting of two orthogonal windings wound around a thin single-domain film is developed. Based on Gilbert's modification of the Landau-Lifshitz equation describing the rotational behavior of the magnetization of the film, this model is valid for both large and small signals and for frequencies up to several hundred megacycles.

RESEARCH ON LOW-POWER MAGNETIC-FILM MEMORIES
Remington Rand, Univac Div., Sperry Rand Corp., San Diego, Calif., Interim engineering rept. no. 2, 14 Aug.-14 Nov. 1963, 14 Nov. 1963, 23 p., AD 424 068.

. . . to demonstrate the feasibility of fabricating microminiaturized evaporated circuitry for use with the low-power magnetic-film memory elements. Passivated chip transistors with attached leads were obtained, and an evaporated bit driver incorporating these units was successfully operated. . . .

Related Publications:

THIN-FILM MEMORIES
E. E. Bittmann, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 92/97.

A small random-access memory using deposited magnetic thin films as storage elements, and with a cycle time of one microsecond, is described. . . . The addressing, driving and sensing circuits are transistorized. . . .

MAGNETIC FILM MEMORIES, A SURVEY
A. V. Pohm, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 308/314, 29 refs.

An analysis is made of the modes of magnetization reversal and rotation in thin ferromagnetic films. The ways in which the various modes can be employed for destructive and non-destructive memories are discussed and their performance limitations considered. Existing film memory efforts are partially surveyed and the material and system problems are examined. Possible future developments are also discussed.

FEASIBILITY STUDY FOR A THIN FILM MEMORY SYSTEM
CBS Labs., Stamford, Conn., Final rept., 28 May 1963, 20 p., AD 406 060.

. . . The model is to be a 4 word 2 bits/word, nondestructive, linear select memory readout and write-in is to be in parallel at a clock frequency of 5mc, and addressing was to be sequential. . .

3A.206: Cryogenic Technology

Included: Thin film superconducting elements; Crowe-cell; Logical cryogenic circuits; Cryotrons in data processors.

Not Included: Refrigerating systems for cryogenic equipment.

Cross References: Cryoelectric memories (3A.267).

Principal Publications:

AN ALGORITHM FOR AUTOMATIC DESIGN OF LOGICAL CRYOGENIC CIRCUITS
E. H. Sussenguth, Jr., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 623/630.

. . . Logical cryogenic circuits differ from the circuitry used with other devices as paths for both the required function and its denial must be provided. Present techniques for logical design of cryogenic circuits either rely on the experience of the designer to achieve a minimal circuit or are derived from analogous relay circuits. An algorithm to develop minimal (or near minimal) circuits by collapsing a complete decoding-tree structure by removing unneeded devices is discussed. . . . A generalization of the algorithm to include functions of n-ary input variables and multiple outputs is also presented.

A PROPOSAL FOR A FAST RANDOM-ACCESS COMPUTER STORE BASED ON THE SUPER-CONDUCTING DEVICE KNOWN AS THE CROWE CELL
J. M. Lock, et al., Solid-State Electronics, vol. 5, Sept./Oct. 1962, p. 301/311.

. . . The Crowe cell is a superconducting device in which information is stored in the form of a persistent current in a circuit of very low self-inductance. . . . switching times of 10-15 musec can be regularly achieved. . . .

TIME AVERAGE THERMAL PROPERTIES OF A COMPUTER UTILIZING THIN-FILM SUPERCONDUCTING ELEMENTS
H. Sobol, IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 200/212.

. . . An experimental program has been conducted to determine the thermal properties of isolated and of thermally coupled gates.

AN 11-CRYOTRON FULL ADDER (Correspondence)
J. S. Squire, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 710/711.

GIGAHERTZ COMPUTER CIRCUITRY
G. L. Hollander, IEEE Trans. Commun. Electronics, no. 67, July 1963, p. 313/317, 25 refs.

. . . For the long range, thin-film cryotrons, with a cost advantage of 100 to 1 over tunnel diodes, show the greatest promise.

APPLICATION OF CRYOGENIC TECHNIQUES TO COMPUTER TECHNOLOGY
R. W. Horn, Aeronautical Electronic and Electrical Lab., Naval Air Development Center, Johnsville, Pa., NADC EL6309, 22 July 1963, lv., AD 416 399.

Related Publications:

A SUPERCONDUCTIVE ASSOCIATIVE MEMORY
P. M. Davies, Proc. A FIPS Spring Joint Computer Conf., May 1962, p. 79/81.

The late Dudley A. Buck suggested the use of cryotrons in what he called a Recognition Unit as early as 1955. . . . now a rather impressive list of references to papers on this subject.

. . . described an associative memory that is capable of performing a number of interesting operations. . . paper contains a clearly written introduction to the uses and advantages of associative memories. . .

SUPERCONDUCTIVE ASSOCIATIVE MEMORIES
R. W. Ahrons, RCA Rev., vol. 24, no. 3, Sept. 1963, p. 325/354.

. . . covers the broad area of superconductive associative memories using cryotrons. A survey of existing read and write processes and circuit arrangements is presented, followed by specific circuit improvements and some logic suggestions. . . .

CRYOELECTRIC MEMORIES
L. L. Burns, Jr., RCA Labs. Div., Radio Corp. of America, Princeton, N. J., Final rept., 1 March 1962-28 Feb. 1963, RADC TDR63 351, Oct. 1963, 256 p., AD 422 950, N64-12027.

. . . describes work on continuous evaporated film cryoelectric memory devices. . . includes basic principles of superconductivity followed by a detailed description of memory operation and a thermodynamic analysis. . . experimental results on 16-bit and 16,384-bit cryoelectric memory planes are given. Studies of the effects of impurities, film thickness, and other parameters are presented.

Section 3A.21: Additional Computer Technologies

3A.212: High Speed Computer Technologies

Included: Nano-second computer elements; Gigahertz computer circuitry; Kilo-megacycle computer technology; Milli-microsecond digital units.

Not Included: Nano-second circuit development.

Cross References: High speed memory units (3A.267); Optical computer technologies (3A.214); Microwave computer technologies (3A.213); Cryogenic computer technologies (3A.206); Tunnel diode logic circuits (3A.224).

Principal Publications:

PROJECT LIGHTNING
IBM Research Center, Yorktown Heights, N.Y., Periodic progress rept., 6 June-31 Aug. 1957, AD 419 811.

The IBM Lightning program is organized around a central Machine Organization Theory project. . . . Work has been done on microwave systems and machine organization theory during the first reporting period.

IBM LIGHTNING PROJECT
IBM Research Center, Yorktown Heights, N. Y., Quarterly progress rept. no. 5, 1 July 1930, Sept. 1958, 30 Sept. 1958, 81 p, AD 418 477.

TRANSISTOR PULSE CIRCUITS FOR 160-MC CLOCK RATES
W. J. Giguere, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 4, Sept. 1959, p. 432/438.

. . . consists of two parts. Part I, by Giguere and Jamison, discusses transitor circuits capable of regenerating 6.25-m μsec pulses at a 160-mc bit rate. Part II, by Noll, discusses techniques for multiplexing 16 digital signals with a 10-mc clock rate into a single signal with a 160-mc clock rate.

MILLIMICROSECOND PULSE TECHNIQUES (Second revised Edition)
I. A. Lewis, and F. H. Wells, London, Pergamon Press Ltd., 1959, 360 p.

MILLIMICROSECOND DIGITAL COMPUTER LOGIC
N. F. Moody, et al., Electronic Engng., vol. 31, Sept. 1959, p. 526/529.

A transistorized fast-pulse logic system which utilizes transformer coupled stages and is tolerant to digit delays is described. . . . Logical circuits for OR, AND, INVERTOR, and RE-CLOCK are presented, together with a driver which permits a "fan out" factor of 5.

SOLID STATE MICROWAVE HIGH SPEED COMPUTERS
J. A. Rajchman, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 38/47.

Phase locked oscillators and tunnel diodes are receiving a good deal of attention with regard to their application in ultra high speed computing machines. This presentation was a qualitative survey of RCA's efforts along these lines.

HIGH SPEED DATA PROCESSOR SYSTEM RESEARCH PROJECT LIGHTNING
RCA Industrial Electronic Products, Camden, N. J., Interim research rept. no. 7A, Supp. Sept. 1, 1960, AD 418 661.

PROJECT LIGHTNING
Radio Corp. of America, Camden, N. J., Supplement to interim research rept. no. 9A, 1 March 1960, AD 418 518.

PROJECT LIGHTNING. VOLUME I. THIRD PHASE
Remington Rand Univac Div., Sperry Rand Corp., St. Paul, Minn., Quarterly rept. no. 2, 1 Sept.-30 Nov. 1960, rept. no. PX1599 2, 30 Nov. 1960, 49 p., AD 418 463.

PROJECT LIGHTNING. THIRD PHASE VOLUME II
Remington Rand, Univac Div., Sperry Rand Corp., St. Paul, Minn., Quarterly rept. no. 1, 1 June-31 Aug. 1960, rept. no. PX159 1, 48 p., AD 418 462 (also AD 418 464).

A 2.18-MICROSECOND MEGABIT CORE STORAGE UNIT
C. A. Allen, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 233/237.

A magnetic core memory is described which has a read-write cycle time of 2.18 μ sec, and a storage capacity of 1,179,648 bits. The array configuration and the design of the driving system are shown.

IBM 7302 Core Storage. . . uses ferrite toroids and is a coincident-current, three-dimensional system; 16,384 words of 72 bits each are addressable by random access in a single array. . .

THE GENERATION OF VERY SHORT PULSES (In German)
H. P. Louis, Bull. Assoc. Suisse Elect., vol. 51, no. 20, Oct. 1961, p. 1067/1072.

A number of methods are discussed for the generation of pulses of millimicrosecond duration. . . .

PROJECT LIGHTING. HIGH SPEED DATA PROCESSOR SYSTEM RESEARCH
RCA Industrial Electronic Products, Camden, N. J. Supplement to interim research rept. no. 10A, 1 June 1961, 123 p., AD 418 519.

. . . A new circuit having properties of both a-c and d-c logic circuits was conceived and extensively explored. Although possessed of great logical flexibility, the circuit does not afford any significant advantage with respect to tolerances. The basic circuit form is that of diode (TR) logic fitting into tunnel diode amplifiers.

DEVELOPMENT IN HIGH-SPEED SWITCHING ELEMENTS
A. W. Lo, Proc. IRE, vol. 50, May 1962, p. 1067/1072.

A NEW APPROACH TO RESISTOR-TRANSISTOR-TUNNEL-DIODE NANO-SECOND LOGIC
W. R. Smith, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 658/664.

HIGH-SPEED DATA PROCESSOR SYSTEM RESEARCH
Radio Corp. of America, Camden, N. J., Interim Research rept. no. 16A (Suppl.), 1 Dec. 1962, 80 p., AD 414 560.

Construction of the 40 gate subsystem was completed and proper operation obtained in both shifting and counting modes above a 300-mc rate.

PROJECT LIGHTNING
RCA Industrial Electronic Products, Camden, N. J. Suppl. to Interim research rept. no. 14A on High-Speed Data Processor System Research, AD 295 405, 1 June 1962, lv. incl. illus., tables, 11 refs., AD 295 645.

. . . A set of logic circuits having reduced delays and increased repetition rate properties was developed. . . . In connection with memory circuit development, a decoder using block-reset tunnel diode logic circuits has been designed for the 32 word memory subsystem. Worst-case total decode time is about 4 nanoseconds.

HIGH-SPEED TRANSISTOR-TUNNEL-DIODE SEQUENTIAL CIRCUITS
J. J. Amodei, et al., RCA Rev., vol. 24, no. 3, Sept. 1963, p. 355/380.

. . . describes some register, counter, and shift-register configurations for operation at high repetition rates. The results show that operation of any of these circuits at clock rates between 100 and 200 mc can be achieved reliably under realistic conditions and using commercially available components. . .

GIGAHERTZ COMPUTER CIRCUITRY
G. L. Hollander, IEEE Trans. Commun. Electronics, no. 67, July 1963, p. 313/317, 25 refs.

. . . various devices and circuits have been proposed. This paper attempts to integrate and give perspective, from a system view-point, to isolated disclosures, by classifying and contrasting various developments with emphasis on the more promising approaches. The first gigahertz computer will probably be made of tunnel-diode baseband circuitry. . . .

COMPOSITE SYNCHRONOUS-ASYNCHRONOUS LOGIC CIRCUITS FOR NANOSECOND COMPUTING
J. F. Kruy, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 173/182.

CIRCUIT TRENDS IN NANOSECOND SWITCHING
P. Meyers, Electronics, vol. 36, Sept. 20, 1963, p. 35/36/38, 17 refs., A64-10785.

. . . types of high-speed switching circuits . . . employ transistors, tunnel-diodes, transistor/tunnel-diode combinations, and storage-diode/tunnel-diode combinations. The gain tolerance characteristics of these circuits are compared.

SYSTEM DESIGN OF A SMALL, FAST DIGITAL COMPUTER
H. Schorr, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 698/706.

. . . a 250 Mc tunnel-diode computer. . . To resolve the disparity between the obtainable arithmetic and main memory speeds, a sophisticated advanced control is used. The advanced control fetches instructions and operands from the main memory before they are actually needed by the arithmetic unit. These instructions and operands are stored in two small, high-speed tunnel-diode memories which are called queues. A third queue, the Storage Access Queue, is used for saving a storage access request if it cannot be serviced immediately.

THE DESIGN OF MODULAR 250-MC COMPUTING CIRCUITRY
B. E. Sear, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 158/163.

The object of this paper is to show that 250-megacycle circuits can be built using standard sized components and a modular packaging construction. . . tunnel diode charge transformer, TDCT, circuits are discussed, and difficult design areas are pinpointed. . . the problems in clock generation and distribution for nanosecond circuits are outlined and a solution for these circuits is given.

RESEARCH ON ULTRAHIGH-SPEED DIGITAL TECHNIQUES. PROJECT CROWNER, PHASE I
Remington Rand, Univac Div. Sperry Rand Corp., St. Paul, Minn., Final rept., 1 Oct. 1962-30 Sept. 1963, 30 Sept. 1963, 38 p., AD 433 510.

HIGH-SPEED DATA PROCESSOR SYSTEM RESEARCH. PROJECT LIGHTNING
RCA Industrial Electronic Products, Camden, N. J., Interim research rept. no. 17A (Final), 1 April 1963, lv., AD 422 755.

. . . Section I summarizes and reports technical details of the operations life testing phase of the major subsystem. . . Section II summarizes. . . The research study. . . directed towards specific high-speed logic and memory circuitry. . . .

Related Publications:

A STUDY OF NANOSECOND PULSE TECHNIQUES IN RADAR TRANSMISSION
C. G. Bachman, Cornell Aeronautical Lab., Inc., Buffalo, N.Y., Rept. no. UB-1426-P-1, RADC TR 61-247, 27 Feb. 1961, 299 p., AD 268 880.

RAPID-TRANSFER PRINCIPLES FOR TRANSISTOR SWITCHING CIRCUITS
A. K. Rapp, et al., IRE Trans. Circuit Theory, vol. CT-8, no. 4, Dec. 1961, p. 454/461.

AUTOMATIC UTILIZATION OF HIERARCHICAL MEMORIES
J. P. Anderson, et al., IEEE Trans. Commun. Electronics, no. 66, May 1962, p. 288/301.

A TUNNEL DIODE-TUNNEL RECTIFIER, 15 NANOSECOND MEMORY
M. M. Kaufman, Solid State Design, vol. 3, Feb. 1962, p. 23/28.

CIRCUITS FOR THE FX-1 COMPUTER
K. H. Konkle, Proc. AFIPS Spring Joint Computer Conf., May 1962, p. 101/112.

The paper describes a set of digital computer logic circuits capable of 50 megapulse per second operation. One section is devoted to construction techniques and the paper concludes with comments upon the results obtained. . . .

A NANOSECOND TIME CODER WITH GREAT ANALYSIS RANGE FOR TIME-OF-FLIGHT EXPERIMENTS
P. Klopf, et al., Presented at the Internatl. Colloq. on Nucl. Electronics, Paris, 25-27, Nov. 1963, (EUR. -491.e) Available from Belgian American Bank and Trust Co., N.Y., Account No. 121.86; N64-15559.

. . . for on-line and off-line time-of-flight analysis was built with the following main characteristics: smallest channel width. . . of one nanosecond. . . input pulses with a risetime up to 20 nanoseconds. . . The development results show the possibility of decreasing the smallest channel width down to 0.25 nanosecond for reliable function. The unit is a combination of a chronotron-type system with the classical Argonne system. Active elements used are tunnel diodes and transistors.

NANOSECOND ANALOG TO DIGITAL CONVERSION
W. Peil, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 794.

A NANOSECOND PARALLEL-PARALLEL BINARY ADDER IMPLEMENTED WITH CURRENT MODE LOGIC BUILDING BLOCKS
W. C. Seelbach, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 311/340.

3A.213: Microwave Computer Technology

Included: Super-high frequency digital systems; Carrier circuit data processing; Modulated signal data processors; Microwave logical circuits; Carrier-type digital computers.

Not Included: Microwave technology in general; Microwave circuit elements.

Cross References: Parametron logic (3A.225); Nanosecond computer technology (3A.212).

Principal Publications:

FAST MICROWAVE LOGIC CIRCUITS
D. J. Blattner, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 297/301.

In a carrier-type digital computer system, binary information can be represented by the presence or absence of an RF pulse in a given time interval. Using stripline printed circuit techniques and point-contact diodes, passive AND and NOT gates were constructed which operate with RF pulses of less than 2 m μ sec duration (i.e., an effective pulse repetition rate of 500 mc), at a carrier frequency of 3000 mc.

A LOGIC DESIGN FOR A MICROWAVE COMPUTER
S. P. Frankel, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 271/276.

The properties of presently available components place special emphasis on two desiderata of logic design for use in a microwave digital computer: 1) Smallness of the number of active elements; 2) elimination of information-cycling paths having delay times comparable or short compared with the bit period, as in the conventional flip-flop. A logic design. . . is described in substantially complete detail.

HISTORY AND INTRODUCTION—MICROWAVE TECHNIQUES FOR COMPUTERS
R. E. Meagher, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 263/265.

NANOSECOND LOGIC BY AMPLITUDE MODULATION AT X BAND
W. C. Ortel, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 265/271.

A basic circuit, consisting of a diode modulator controlled by the signal from a diode detector, may perform logical AND, EXCLUSIVE-OR and OR functions upon pulsed microwave signals. Pulse rates up to 500 mc have been used at a carrier frequency of 11,000 mc. . . . a digital arithmetic unit has been built which multiplies two 8-digit binary numbers. Various forms of the basic circuit have been studied in operation.

MICROWAVE LOGIC CIRCUITS USING DIODES
W. Sauter, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 302/307.

It is possible to control the transmission of microwave power in a waveguide via external control of the dc bias on a semiconductor diode mounted across the waveguide in a direction parallel to the E field. The combination of a microwave detector with such a modulator affords a means whereby RF power in one waveguide can be made to control RF power in a second waveguide.

Using an X-band carrier, binary pulse stability was observed at pulse repetition rates of 685 mc.

ONR SYMPOSIUM ON MICROWAVE TECHNIQUES FOR COMPUTING SYSTEMS
M. C. Yovits (Symposium Chairman), IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 262.

HIGH-FREQUENCY COMPUTING DISCONTINUOUS AUTOMATION
M. S. Neiman, Radio Engng: Transl. of Radiotechkhnika, vol. 15, no. 3, 1960, p. 7/15.

. . . The possibilities of using the methods of high-frequency radio engineering in the field of discontinuous automation and in particular the problems of the construction of super high-frequency trigger circuits are examined. Restrictions connected with the finite speed of propagation of electromagnetic disturbances are noted. . . .

BASES FOR THE CONSTRUCTION OF DIGITAL SUPER-HIGH FREQUENCY AUTOMATIC SYSTEMS
M. S. Neiman, Radio Engng: Transl. of Radiotekhnika, vol. 15, no. 10, 1960, p. 1/11.

A SPIN-ECHO MEMORY FOR A CARRIER TYPE DIGITAL COMPUTER
L. K. Wanlass, Electronics Research Lab., U. of Calif., Berkeley, Series no. 60, Issue no. 399, 28 Aug. 1961, 149 p., illus., tables, refs., AD 284 290.

. . . A general study is made of solid state paramagnetic crystals as possible storage materials. Spin-spin and spin-lattice relaxation times are considered in general . . . complete carrier computer regenerative memory system using two spin-echo devices and a single connecting channel was considered. The storage capacity of the memory device was theoretically determined.

DIRECTIONAL COUPLERS AS MICROWAVE LOGIC (Correspondence)
T. A. Kriz, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 915/916.

Related Publications:

SPECTRUM-SELECTION AUTOMATIC FREQUENCY CONTROL OF ULTRA-SHORT-PULSE SIGNALLING SYSTEMS
H. Kihn, et al., RCA Rev., vol. 20, no. 3, Sept. 1959, p. 499/517.

. . . maintains a constant frequency difference between a carrier frequency modulated by ultra short pulses of 10 millimicrosecond duration and a local electrically tuned oscillator. The pulse spectrum distribution is an order of magnitude greater than for existing systems but the circuitry is simple and easily aligned and uses commercially available miniature tubes. . . . problem of holding constant the frequency difference between a pulsed carrier source such as a magnetron and a local oscillator (klystron or equivalent). . .

FREQUENCY DOMAIN APPLICATIONS TO DATA PROCESSING
M. A. Martin, IRE Trans. Space Electronics and Telemetry, vol. SET-5, no. 1, March 1959, p. 33/41.

. . . The only filters discussed in this paper are those for which the weights are either symmetric or skew symmetric about the center weight. . . . possible to design low low-pass filters to determine means and trends, low-pass filters to smooth data, sampling filters for frequency analysis, differentiators, integrators, etc. . . .

PARAMETRIC PHASE-LOCKED OSCILLATOR—CHARACTERISTICS AND APPLICATIONS TO DIGITAL SYSTEMS
L. S. Onyshkevych, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 277/286.

The ability of the Parametric Phase-Locked Oscillator (PLO) to detect, amplify, and store binary digital signals, in the form of two distinct phases of a carrier, makes it possible to use the device as the sole component in a digital computer system. The variable-capacitance version of the device operates readily at kilomegacycle frequencies, thus forming the basis of a digital computer at a kilomegapulse clock rate.

SOME NOTES ON THE DESIGN OF MICROWAVE STRIPLINE COMPONENTS
M. Blumberg, Lockheed Aircraft Corp., Sunnyvale, Calif., Technical rept. on Ground Digital Electronics, rept. no. 6-90-62-33, 30 April 1962, 51 p., incl. illus., table, refs., AD 282 781.

. . . development of semiconductor microwave switches in strip transmission line is considered in some detail, with circuit diagrams and oscillograms of waveforms.

OSCILLOSCOPIC TECHNIQUES AT MICROWAVE FREQUENCIES
A. N. Bukin, et al., Leningrad, Leningrad University Press, 1963, 212 p.

. . . The book should prove useful to those who work in the microwave field, who use nanosecond pulses, or are engaged in the development of oscilloscopes. . .

3A.214: Optical Computer Technologies

Included: Optical data processors; Magneto-optic devices for computers; Light pulses as data handling elements; Opto-electronic logic; Photostore; Optical memory drum; Optical fiber techniques for data processing; Photo-electric information processing; Solid state opto-electronics for data processors; Electro-optical shift register.

Not Included: Advanced electro-optical techniques for space communications (3B); Lasers (3B); Fiber optics in general (3B).

Cross References: Microwave computer technology (3A.213); Optical memory units (3A.267); Flying spot storage devices (3A.263); Photographic mass storage devices (3A.360); Shift registers in general (3A.25).

Principal Publications:

OPTICAL INFORMATION HANDLING WITH THIN MAGNETIC FILMS
L. Kleinrock, Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 789/797.

. . . considers an optical method for extracting stored information from thin magnetic films based on the Kerr magneto-optic effect. . . . Thus, the state of a thin magnetic film, which is represented by its magnetic polarity, may be detected optically in a nondestructive manner. However, the effect is rather small, and as such, is not particularly useful. This paper describes attempts to increase the effect, and in fact, shows that it can easily be increased by a factor somewhat greater than 5. The theory indicates that this factor can be further increased, and suggestions for future research along these lines are indicated.

AN ELECTRO-OPTICAL SHIFT REGISTER
T. E. Bray, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 113/117.

. . . composed only of electroluminescent (EL) and photoconductive (PC) cells was designed and successfully operated. . . . amenable to construction in an extremely small volume. . .

DATA PROCESSING BY OPTICAL TECHNIQUES
L. J. Cutrona, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 23/26.

SOLID-STATE OPTOELECTRONICS
E. E. Loebner, RCA Rev., vol. 20, no. 4, Dec. 1959, p. 715/743.

. . . description of optoelectronic modulators and amplifiers, i.e., devices which have mixed optical and electrical signal and power access. . . . The functioning of various optoelectronic logic nets and computer components is treated in detail. . . . a synthesis of panel technology and logic circuitry into novel picture-processing panels and computer systems is proposed.

STUDY OF OPTICAL FIBER TECHNIQUES FOR DATA PROCESSING
C. J. Koester, American Optical Co., Southbridge, Mass., Final rept, RADC TDR 62-478, Aug. 1962, 41 p., AD 299 007.

CONSIDERATIONS IN OPTOELECTRONIC LOGIC AND MEMORY ARRAYS
T. E. Bray, General Electric Co., Electronics Lab., Syracuse, N. Y., Presented at the 1962 Symp. on Opt. Process. of Inform., Wash., D. C., Jan. 1963, 34 p., 23 refs., N63-18905.

. . . characteristics of polycrystaline electroluminescent and photoconductive materials which affect the speed and size of optoelectronic logic and memory arrays, are discussed.

ANALYSIS OF A MAGNETO-OPTIC READOUT SYSTEM
G. Fan, et al., IEEE Trans. Electronic. Comp., vol. EC-12, no. 1, Feb. 1963, p. 3/9.

The signal and signal-to-noise ratio in a typical magneto-optic readout scheme intended for use in a high-capacity high-speed memory were analyzed. It was found that such a system does not yield higher signal levels and signal-to-noise ratios than are available with conventional magnetic head readout in such a peripheral memory.

STUDY OF REUSABLE PHOTOSENSITIVE ELECTRON RECORDING MEDIA
F. F. Hall, ITT Federal Labs., San Fernando, Calif., Final Rept., 15 April 1961-15 Dec. 1962, ASD TDR63 284, May 1963, 124 p., AD 404 665.

A COMPUTER FIXED STORE USING LIGHT PULSES FOR READ-OUT
G. R. Hoffman, et al., J. Brit. Instn. Radio Engrs., vol. 25, no. 2, Feb. 1963, p. 99/106.

. . . has an access time of 20 ns and can be interrogated every 100 ns. Information is stored on a punched card, or photographic matrix, and interrogation is by means of light pulses transmitted along optical systems composed of bunches of fine transparent optical fibres. . . .

HIGH DENSITY OPTICAL MEMORY DRUM
W. W. Lee, Eclipse Pioneer Div., Bendix Corp., Teterboro, N. J., Final rept., Feb. 1961-May 1962, ASD TDR 62-791, Feb. 1963, 49 p., AD 401 644.

. . . manufacture of high density permanent storage devices for digital computers using optical techniques . . . capacity of over a million bits and occupies approximately 1/8 cu. ft.

RESEARCH IN ADVANCE PHOTOELECTRIC INFORMATION STORAGE
W. G. Reininger, et al., AF Avionics Lab., Final Report, June 1962-July 1963, Rept. 437 D/RTD-TDR-63-4134, Nov. 1963, 138 p., refs., AD 423 982, N64-12188.

. . . The state-of-the-art of the components of a tape camera storage tube, which image information is written by photo-electrons magnetically focused as an electron charge pattern on the storage tape . . . Improvements increased resolution from 40 to the present 75 line pairs/mm. . . .

COMPUTER SET AN/GSC-16 (XW-2), VOLUME V. THE SYSTEM TECHNICAL DESCRIPTION. SECTION I: PHOTOSTORE
T. J. Watson Research Center, Yorktown Heights, N. Y., Final Rept., RADC TDR 63 100, vol. 5, sect. 1, 23 Sept. 1963, 132 p., AD 431 656.

The Disc Reader is the central novel unit of the . . . equipment. In it a disc which has been loaded with 64.5 x 10 to the 6th power bits of information is read on instruction from the Search and Analysis Logic. . . .

Related Publications:

HIGH-SPEED, HIGH-CAPACITY PHOTOGRAPHIC MEMORY
C. A. Lovell, Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 34/38.

OPTICAL ANALOG COMPUTERS
B. J. Howell, J. Opt. Soc. Amer., vol. 49, Oct. 1959, p. 1012/1021.

THE RAYSISTOR, AN ELECTRICAL TRANSFORMER USING OPTICAL COUPLING
J. C. Davis, Jr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 212/213.

. . . The Raysistor consists of a fast, high-intensity light driving a sensitive, fast, photoresistive cell. . . .

HOLLOW-CATHODE GENERATOR OF NANOSECOND LIGHT PULSES
R. W. Lomax, et al., Elect. Commun., vol. 37, no. 4, 1962, p. 367/376.

3A.215: Ultra-sonic Technologies in Data Processing

Included: Photoelectric data processing elements.

Not Included: Piezo-electric transducers; Magneto-strictive elements.

Cross References: Delay lines as short-time buffers (3A.265); Bibliographies with references on ultra-sonic devices (3A.265).

Principal Publications:

PHOTOELASTIC ULTRASONIC DELAY LINES
H.A. Brouneus, et al., Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 835/839.

. . . high-efficiency transducers have now been made. With them can be realized continuously variable time delay and multiple tapping. They have also the capability of providing addition or multiplication of two or more signals by proper arrangement of optical elements.
. . . have been operated at frequencies up to 30 megacycles with delays up to 160 microseconds. . . .

AN EXPERIMENTAL 600-FOOT ELECTRO-SONIC DELAY LINE FOR THE NAVY SPACE SURVEILLANCE SYSTEM
M.G. Kaufman, Naval Research Lab., Washington, D.C., NRL R5927, 22 May 1963, 12 p., AD 409 494.

. . . The requirement for delaying the composite (IRIG) FM telemetering signals from a Space Surveillance site by one-half second was fullfilled by converting the phone-line frequencies into sound, which is then transmitted through a pipe long enough to provide the desired delay . . .

Related Publications:

MAGNETOSTRICTIVE ULTRASONIC DELAY LINES FOR A PCM COMMUNICATION SYSTEM
D.A. Aaronson, et al., IRE Trans. Electron. Computers, vol. EC-9, no. 3, Sept. 1960, p. 329/332.

A servo-operated delay-line pad and a temperature-compensated delay-line memory, both magnetostrictively driven at 1.5 mc, have been used in an experimental PCM communication system. . . .

STUDY OF INCORPORATION OF SOUND ON TRANSPARENCY
B.B. Bauer, et al., CBS Labs., Stamford, Conn., NAVTRADEVCEN TR-1084-1, Nov. 1962, 41 p., AD 297 812.

Section 3A.22: Logical Units

3A.220: Digital Logic Circuits

Included: Logical machine design; Computer logic circuits; Symbology for digital systems; Books on switching circuits.

Not Included: Pulse circuitry in general; Transient analysis of electronic circuits.

Cross References: Arithmetic units of computers (3A.24); Control units of data processors (3A.25); Theory of switching systems (3A.120); Automata (3A.016).

Principal Publications:

PULSE TECHNIQUES
S. Moskowitz and J. Racker, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1951, 308 p.

The book starts with a discussion of characteristics of pulses. Transient response of linear networks is treated making use of Laplace transforms. Filters, transformers, and delay lines are covered in a discussion of pulse networks. Linear pulse amplifiers, pulse shaping and clamp circuits, and pulse regeneration are considered next. The last three chapters cover pulse measurements and instruments, pulse communication systems, and antenna navigation aids.

LOGICAL MACHINE DESIGN: A SELECTED BIBLIOGRAPHY
D.B. Netherwood, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 155/178.

. . . An essential feature of the report is the extensive index of significant title words. Each indexed work is given in the complete context of the title in which it occurs.

A LOGIC DESIGN FOR A MICROWAVE COMPUTER
S. P. Frankel, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 271/276.

. . . A logic design . . . is described in substantially complete detail.

LOGICAL MACHINE DESIGN II: A SELECTED BIBLIOGRAPHY
D.B. Netherwood, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 367/380.

The bibliography which appeared in the June, 1958, issue of these Transactions is extended to a total of 777 titles. The original format is retained, but in this supplement the scope of material is restricted to technical publications pertaining to the logical design of machines.

ELECTRONIC SWITCHING, TIMING, AND PULSE CIRCUITS
J. M. Pettit, New York, McGraw Hill Book Co., Inc., 1959.

COMPUTER LOGIC
I. Flores, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1960, 458 p.

This book, which is appropriately subtitled "The Functional Design of Digital Computers," fills an important gap in the computer literature. Most books in the computer field are either textbooks to teach a particular subject, such as programming or logic design, or collections of descriptions of various hardware techniques, often those used in existing machines.

IMPUL'SNAIA TEKHNIKA (Pulse Engineering) (In Russian)
V.T. Frolkin, Moscow, Izd. Soviet Radio, 1960, 360 p.

. . . operation, design and development of radio engineering systems for the generation, amplification and conversion of electrical oscillations of various shapes as used in television, radar, radio-control, computers and in industrial radio-electronics. . . . intended as a textbook for students . . .

NONLINEAR ELECTRICAL NETWORKS
W. L. Hughes, New York, Ronald Press Co., 1960, 296 p.

IMPUL'SNYYE REZHIMY V RADIOTEKHNICHESKIKH TSEPYAKH (Pulse Operation in Radio Engineering Circuits) (In Russian)
V. V. Nelepets, V.S. Nelepets, Moscow, Oborongiz, 1960, 182 p.

. . . describes the physical processes in pulse operation in various radio circuits. . . . problems associated with conversion, generation and amplification of pulse signals . . . presented without the use of higher mathematics . . .

PROPOSED SYMBOLOGY FOR DIGITAL SYSTEMS
Ad Hoc Group, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 629.

Summary Only.
This report has been prepared as an urgently needed reference in three application fields; (1) algebraic symbols used in logical expressions, (2) graphical logic symbols for manually prepared logic diagrams, (3) printed graphical symbols for logic diagrams prepared by high speed printers. A uniform symbology is proposed that will carry unchanged meaning from design to maintenance. . . .

SUMMER INSTITUTE FOR SYMBOLIC LOGIC SUMMARIES (Cornell University, 1957) (2nd ed.)
Communications Res. Div. Inst. for Defense Analyses, Princeton, N.J., July 1960.

This volume has 83 articles, 17 of which are in the fields of switching theory, theory of automata, computer design and computer programming, and will be reviewed here.

ITERATIVE ARRAYS OF LOGICAL CIRCUITS
F.C. Hennie, III., Massachusetts Institute of Technology, Cambridge, Mass., MIT Press, and New York, John Wiley and Sons, Inc., 1961, 242 p.

. . . generalizes iterative circuits from previously studied one-dimensional unilateral circuits to systems of circuits having higher dimension and having interconnections in more than one direction. . . . for specialists, particularly those doing research in automata or switching theory. . . .

BIBLIOGRAPHY ON SWITCHING CIRCUITS AND LOGICAL ALGEBRA
P.A. Holst, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 638/661.

. . . Covers material published through 1958, contains nearly 700 references to articles, books, seminars, and other bibliographies pertaining to the theory of switching circuits and logical algebra.

TRANSISTOR LOGIC CIRCUITS
R.B. Hurley, New York, John Wiley & Sons, Inc., 1961, 355 p.

ADVANTAGES AND DISADVANTAGES OF VARIOUS CIRCUITS IN PULSE TECHNIQUES (In German)
G. Laskowski, Nachrichtentech. Z., vol. 11, no. 4, April 1961, p. 173/176.

Discussion of the more important circuit arrangements employing transistors for pulse working with particular attention to attainable speeds of operation, energy dissipation and the required output. The arrangements considered are: d.c.-coupled circuits, diode techniques, resistance-capacitance coupled-circuits and current switching mode. . . .

PROPOSED SYMBOLOGY FOR DIGITAL SYSTEMS
AIEE Committee Report, Commun. and Electronics, vol. 79, no. 52, Jan. 1961, p. 787/793.

COMPUTER LOGIC CIRCUITS
M.R. Haskard, et al., Proc. Instn. Radio Engrs. Australia, vol. 23, no. 3, March 1962, p. 183/190.

. . . design of a set of logic circuits for a digital computer (CIRRUS). The first part concerns the results of evaluation tests on various circuit configurstions and suitable components. . . . design procedure for the selected configuration which is based on worst-case analysis. . . .

THE COMPONENTS AND UNITS OF CONTACT-LESS TELEMECHANICAL SYSTEMS (In Russian)
D. P. Losev, Leningrad, Subpromgiz, 1962, 247 p.

SOME ASPECTS OF THE LOGICAL DESIGN OF A CONTROL COMPUTER: A CASE STUDY
R. L. Alonso, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 687/697.

. . . the Apollo Guidance Computer (AGC) . . . is an onboard computer for one of the forthcoming manned space projects, a fact which is relevant primarily because it puts a high premium on economy and modularity of equipment, and results in much specialized input and output circuitry.

The computer is a parallel, single address machine with more than 10,000 words of 16 bits. Such a short word length yields advantages of efficient storage and speed, but at a cost of logical complexity in connection with addressing, instruction selection, and multiple-precision arithmetic.

TRENDS ON LOGIC CIRCUIT DESIGN
A. Lambert, Electronics, vol. 36, Dec. 6, 1963, p. 38/45, 12 refs., A64-11683.

AN INSTRUCTIONAL AID FOR DIGITAL COMPUTER LOGIC
C. J. Lingwood, et al., J. Brit. Inst. Radio Engrs., vol. 25, no. 4, April 1963, p. 335/352.

SWITCHING CIRCUITS FOR ENGINEERS
M. P. Marcus, Englewood Cliffs, N. J., Prentice-Hall, Inc., 1962.

SEMICONDUCTOR DEVICES IN PULSED AND SWITCHING CIRCUITS (In Russian)
V. V. Shtager, Moscow-Leningrad, Gosenergoizdat, 1963, 190 p.

AN ANNOTATED BIBLIOGRAPHY ON NOR AND NAND LOGIC
C. D. Todd, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 462/464.

A bibliography containing 63 references to papers dealing with NOR and NAND gate design and application composes this paper. . . . A one or two sentence summary is given for each reference.

Related Publications:

NEURISTOR LOGIC
H. D. Crane, et al., Computer Techniques Lab., Stanford Research Inst., Menlo Park, Calif., Interim rept. no. 5 (Final), ASD TDR 62-552, April 1962, 180 p., incl. illus., 20 refs., AD 282 497.

3A.221: Logical Design Methods

Included: Redundant logical design; Signal degeneration in logic circuits; Current switching in logic devices; Automated logical design; Quadded logic; Or-invert logical circuits; And-invert logical circuits; Analysis of logical elements; Multiple-output logical networks; Stability of locigal networks; Forcing circuitry.

Not Included: Reliability theory in general; Logical synthesis.

Cross References: Reliability in data processing systems (3A.162); Self-repair methods in computing systems (3A.170); Effect of interconnections between logic elements (3A.282); Theory of switching circuits (3A.120).

Principal Publications:

TRANSISTOR CIRCUIT ENGINEERING
R. F. Shea (editor), New York, John Wiley and Sons, Inc., 1957, 488 p.

. . . Written by members of the General Electric staff; eight co-authors collaborated . . . "a proper mixture of basic transistor theory with examples of its proper application in typical circuits."

IMPROVEMENTS TO CURRENT SWITCHING
F. K. Buelow, IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 415/418.

Diode switching circuits have been used in conjunction with emitter followers and current switching circuits to evolve a new set of system building blocks. These blocks exhibit typical delays under five millimicroseconds. Diodes cost less and are physically smaller than transistors; therefore, this new system is cheaper and faster than an all-current switching system and permits at least a five-fold increase in packaging density.

CYCLES IN LOGICAL NETS
J. H. Holland, J. Franklin Inst., vol. 270, Sept. 1960, 202/226.

. . . examine the relation between the complexity of the cycles in a logical net and the complexity of the resulting behavior. The author's method is to use periodic input as a tool for analyzing net properties. By this interesting procedure, he is able to prove some theorems that would be very awkward to prove in any other way.

THE USE OF PARENTHESIS-FREE NOTATION FOR THE AUTOMATIC DESIGN OF SWITCHING CIRCUITS
E. L. Lawler, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 342/352.

. . . introduced for the representation of series-parallel switching networks. The notation facilitates the calculation of circuit parameters and permits an unambiguous characterization of the circuit topology.

COMPUTER DESIGN OF MULTIPLE-OUTPUT LOGICAL NETWORKS
T. C. Bartee, IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961. p. 21/30.

An important step in the design of digital machines lies in the derivation of the Boolean expressions which describe the combinational logical networks in the system. Emphasis is generally placed upon deriving expressions which are minimal according to some criteria. A computer program has been prepared which automatically derives a set of minimal Boolean expressions describing a given logical network with multiple-output lines.

MATHEMATICAL CIRCUIT ANALYSIS AND DESIGN
A. Brown, et al., Remington Rand Univac Div., Sperry Rand Corp., Philadelphia, Pa., Scientific rept. no. 2, March 1961, 67 p., AD 259 786.

. . . A detailed mathematical description of the technique for determining the maximum component tolerance is included and the subsequent statistical study indicates the importance of the maximum tolerance determination in circuit design.

STABILITY OF LOGICAL NETWORKS AND ITS APPLICATION TO IMPROVEMENT OF RELIABILITY
K. K. Maitra, IRE Trans. Circuit Theory, vol. CT-8, no. 3, Sept. 1961, p. 335/341.

SYSTEMATICALLY INTRODUCED REDUNDANCY IN LOGICAL SYSTEMS
W. C. Mann, IRE Internat. Conv. Rec., vol. 2, March 1961, p. 241/263.

FORCING CIRCUITRY: SEQUENTIAL BUILDING BLOCKS FOR LOGICAL DESIGN
R. M. Meade, Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 522/531.

. . . This paper first reviews the current-switching circuits which were developed to solve the problem of integrating storage with logical transformation and of stabilizing data for storage. Radical improvements are then introduced in the form of the forcing circuits, which reduce the delays and cost and increase the logical power of the sequential elements. . . .

A SYSTEMATIC METHOD FOR COMPUTER SIMPLIFICATION OF LOGIC DIAGRAMS
F. A. Rocket, IRE Internat. Conv. Rec., vol. 2, March 1961, p. 217/223.

TWO APPROACHES TO INCORPORATING REDUNDANCY INTO LOGICAL DESIGN
L. dePian, et al., In: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 379/388.

. . . two different approaches to the synthesis of logical circuits incorporating redundant functional elements. The principles underlying these two methods are: (1) Statistical averaging; (2) Majority correction.

DESIGN OF COMPUTER CIRCUITS USING LINEAR PROGRAMMING TECHNIQUES
G. H. Goldstick, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 518/530.

. . . design equations and conditions required to synthesize a diode-coupled inverter and a design procedure for achieving an optimum circuit are presented. . . . .

QUADDED LOGIC
J. G. Tryon, In Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 205/228.

. . . describes the design of logic nets which are immune to errors caused by a permanent failure or a temporary malfunction of one or more of the nets' elements. The elements are logic circuits (AND, OR, NOT) of the gate type.

CODING FOR LOGICAL OPERATIONS
S. Winograd, IBM J. Res. Developm., vol. 6, Oct. 1962, p. 430/436.

The present paper is concerned (as were the papers of Elias, and Peterson and Rabin) with the question of whether computing systems . . . might also be subject to a fundamental limitation on signal redundancy like Shannon's coding theorem. In particular, the question arises of whether switching networks possess a "computation capacity" analogous to the transmission capacity of a communications channel.

A METHOD OF THEORETICAL ANALYSIS OF HIGH-SPEED JUNCTION DIODE LOGIC CIRCUITS
Y. Cho, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 492/502.

AUTOMATED LOGICAL DESIGN
H. F. DeFrancesco, et al., IEEE Internat. Conv. Rec., Pt. 4, vol. 11, March 1963, p. 94/101.

A CATALOG OF THREE-VARIABLE OR-INVERT AND AND-INVERT LOGICAL CIRCUITS
L. Hellerman, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 198/223.

This report gives a complete catalog of minimal NOR circuits and minimal NAND circuits, assuming complements not available, for all logic functions of three variables. Minimal circuits for a function are those that satisfy these conditions: (1) The number of logic blocks of the circuit is least possible for performing the function; (2) The number of connections in the circuit (total number of inputs) is least possible, subject to the condition that the circuit satisfies the first condition.

OPTIMIZATION OF PULSE AND DIGITAL CIRCUITS BY USE OF THE LAGRANGE MULTIPLIER TECHNIQUE
D. A. Pierre, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 488/492.

Equations are derived for the optimal design of a frequency divider circuit, and optimal design equations are presented for other typical pulse circuits: a timing circuit, a gating circuit and a clipping circuit. The Lagrange Multiplier Technique used in this paper has also been applied successfully for the optimal design of switching amplifiers.

PREDICTING SIGNAL DEGENERATION AND GATE COMPATIBILITY IN LOGIC CIRCUITS
W. H. Pierce, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 277/281.

A simple graphical analysis of the output vs input curves of a digital circuit will show whether the circuit can be used in arbitrarily long logical chains. The analysis uses upper and lower bounds for the output vs input curves, but these bounds can be interpreted as statistical confidence limits. Results of the analysis give necessary and sufficient conditions for various different types of gates to be compatible.

NETWORK CODING FOR RELIABILITY
J. Tooley, Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 407/414, 11 refs.

. . . A redundancy technique for combinational logic networks is described which, for a given redundancy level, permits a much greater reliability improvement than do the classic techniques. This is made possible through new device design and the incorporation of the logic of error correcting codes in the system logic. By exploiting the properties of integrated circuits this technique promises to make passive self-repair through redundancy a practical solution to some of the reliability problems associated with nonrepairability. . . .

Related Publications:

SEMICONDUCTOR CIRCUIT DESIGN PHILOSOPHY FOR THE CENTRAL CONTROL OF AN ELECTRONIC SWITCHING SYSTEM
B. J. Yokelson, et al., Bell Syst. Tech. J., vol. 37, no. 5, Sept. 1958, p. 1125/1160.

The advent of electronic switching has necessitated a considerable number of changes in the circuit design philosophy employed in the electromechanical switching art. . . . circuit design for the central control of an electronic switching system. . . . low cost consistent with good margins, reliability and the meeting of systems requirements.

ALGORITHMS FOR LOGICAL DESIGN
A. C. Ewing, et al., Commun. and Electronics, vol. 80, no. 56, Sept. 1961, p. 450/458.

A series of "extraction algorithms" are presented that are applicable to the design of a wide class of combinational circuits. A special operation, the #-product, is introduced for carrying out these algorithms. Complete algorithms for the design of minimal and near-minimal 2-level and/or circuits are given . . . These algorithms have been programmed for the ... . . . (IBM) 704 and are available through the Share Library.

THE EFFECTS OF INTERCONNECTIONS ON HIGH-SPEED LOGIC CIRCUITS
D. B. Jarvis, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 476/487.

AUTOMATIC TROUBLE DIAGNOSIS OF COMPLEX LOGIC CIRCUITS
S. H. Tsiang, et al., Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 575/583.

3A.222: Special Logic Techniques

Included: Threshold logic; Higher-order logic; Majority-decision logic; Variable threshold TRL circuits; Threshold gate networks.

Not Included: Decision theory (2); Null-tone decision devices (2); Threshold switching circuits.

Cross References: Quadded logic (3A.221).

Principal Publications:

THE THEORY OF MAJORITY DECISION ELEMENTS (In Japanese)
S. Muroga, et al., J. Inst. Elect. Commun. Engrs. Japan, vol. 43, no. 10, Oct. 1960, p. 1071/1083.

Logical elements on the majority-decision (MD) principle, such as magnetic cores and parametrons, play an important role in the field of electronic computers. Such elements, with slight structural modifications, can represent a wide variety of logical functions. . . .

DETERMINATION OF THE STRUCTURE OF A MAJORITY-DECISION ELEMENT BY THE METHOD OF LINEAR PROGRAMMING (In Japanese)
S. Muroga, et al., J. Inst. Elect. Commun. Engrs. Japan, vol. 43, no. 12, Dec. 1960, p. 1408/1411.

. . . The method of linear programming yields a criterion as to whether a given Boolean function can be realized or not by a single majority-decision element. The method also determines the most economical structure (coupling numbers and thresholds) of a majority-decision element realizing the function. . . .

MAJORITY GATE LOGIC IMPROVES DIGITAL SYSTEM RELIABILITY
G. Buzzell, et al., IRE Internat. Conv. Rec., vol. 2, March 1961, p. 264/270.

AXIOMATIC MAJORITY-DECISION LOGIC
M. Cohn, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 17/21.

An algebra suited to logical design with majority-decision elements (parametrons, Esaki diodes, etc.) is developed axiomatically. The utility of the new algebra is demonstrated by resolving sample problems.

THEORY OF MAJORITY DECISION ELEMENTS
S. Muroga, et al., J. Franklin Inst., vol. 271, May 1961, p. 376/418.

MORE ABOUT THRESHOLD LOGICS
R.O. Winder, Proc. AIEE 2nd Annual Symp. Switching Circuit Theory, Oct. 1961, p. 55/64.

WORST CASE DESIGN OF VARIABLE-THRESHOLD TRL CIRCUITS
W.J. Wray, Jr., IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 382/390.

Now that standard Transistor Resistor Logic is well understood and widely used, the possibilities for reducing component count by changing the height of the switching threshold, as measured in units of input, are being explored. This paper presents the worst case design formulation, both steady-state and transient, for such variable-threshold circuitry.

A REALIZATION PROCEDURE FOR THRESHOLD GATE NETWORKS
C.L. Coates, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 454/461.

One engineering parameter of importance in the realization of threshold gate networks is the tolerance which must be placed on the coefficients and threshold of the individual components. A previous paper gives a realization procedure which allows this tolerance to be controlled. The present paper gives an alternate realization procedure which also allows the tolerance to be controlled, but which is somewhat different in its application.

TERNARY THRESHOLD LOGIC
W.H. Hanson, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 191/197.

A new logical algebra, ternary threshold logic, is defined and developed. The system is shown to be capable of representing all three-valued functions, and two methods of synthesizing these functions from their truth tables are given.

REALIZATION OF LOGICAL FUNCTIONS BY A NETWORK OF THRESHOLD COMPONENTS WITH SPECIFIED SENSITIVITY
P.M. Lewis, II, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 443/454.

In the realization of a logical function by a network of threshold components, one important engineering parameter is the tolerances which must be placed on the coefficients and threshold of the individual components. . . . a procedure is given for realizing an aribtrary logical function as a network of threshold components with specified sensitivity.

3A.223: Special Logic Circuits and Modules

Included: Resistor-transistor logic circuits (RTL); Hybrid logic circuitry; Transistor logic circuitry; Transistor-resistor logic circuits (TRL); Current operated diode logic gates; Gating circuits.

Not Included: Theory of transistor circuits; Solid state circuitry in general.

Cross References: Digital arithmetic units (3A.24).

Principal Publications:

TRANSISTOR CHARACTERISTICS FOR DIRECT-COUPLED TRANSISTOR LOGIC CIRCUITS . . .
J.W. Easley, IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 6/16.

. . . The basic requirement for stability of a direct-coupled transistor logic (dctl) circuit is that a voltage margin exist between the maximum collect-emitter voltage of an "on" unit in the system environment and the minimum base-emitter voltage required for a transistor to be sufficiently "off".
. . . Methods for the specification of acceptance requirements of dctl transistors and the relation of these specifications to logic design rules are discussed.

DIRECT-COUPLED TRANSISTOR LOGIC CIRCUITRY . . .
J.R. Harris, IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 2/6.

Direct coupled transistor logic circuitry lends itself to systematic design methods and performs remarkably well. Logical design rules are given for use with transistors which meet specifications treated in a companion paper. The implications of the use of silicon transistors are discussed.

ANALYTICAL DESIGN OF RESISTOR-COUPLED TRANSISTOR LOGICAL CIRCUITS
M.W. Marcovitz, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 109/119.

. . . Used in the mechanization of logical operations. The basic circuit consists of one transistor and a number of resistors. This circuit performs the OR function followed by the NOT function or the AND function followed by the NOT function. With these compound functions mechanized it is possible to build any logical system.

A GENERALIZED RESISTOR-TRANSISTOR LOGIC CIRCUIT AND SOME APPLICATIONS
S.C. Chao, IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 8/12.

. . . the output produces a signal when any m out of the n imputs are "on." Practical limitations such as using precision power supplies and components are discussed.

INTEGRATED DEVICES USING DIRECT-COUPLED UNIPOLAR TRANSISTOR LOGIC
J.T. Wallmark, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 98/107.

. . . material that is new in three area. First, a new logic system using directly-coupled unipolar transistors is analyzed. . . . Second, devices of extreme miniaturization built by an integrated device design and using this logic system are described. Third, how the passive components of the system, in this case resistors, have been integrated into the semiconductor devices is described.

GENERALIZED RTL CIRCUITS — SUPPLEMENTARY (Correspondence)
S.C. Chao, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 371/372.

. . . In the analysis, approximations were made by assuming zero base-emitter and zero saturation voltage drop across the transistor junctions. . . . A supplementary analysis is presented here, taking into consideration the finite junction voltage drops of a transistor.

STATISTICAL ANALYSIS OF TRANSISTOR-RESISTOR LOGIC NETWORKS
W.J. Dunnet, et al., IRE Trans. Circuit Theory, vol. CT-7, Aug. 1960, p. 100/129.

. . . In particular, we are concerned with TRL circuits which use resistive coupling between grounded emitter stages to perform the logical NOR function. . . . A computer program was written to simulate the model on an IBM 709. By using measured statistical data of transistor parameters and randomly sampled circuit variables as input, a Monte Carlo analysis of the distribution of propagation delay is carried out.

COMPARISON OF SATURATED AND NON-SATURATED SWITCHING CIRCUIT TECHNIQUES
G.H. Goldstick, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 161/175.

. . . The switching efficiency, a figure of merit based on the charge storage properties of the transistor, is introduced. . . . Currently-used antisaturation techniques are discussed.

SYSTEM APPLICATION OF HYBRID LOGIC CIRCUITRY
J.T. Lynch, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 418/423.

A comparative performance rating of circuit techniques for performing logical functions in digital systems may be based upon: (1) Reliability and simplicity, (2) Input and output capabilities (3) Propagation time (4) Cost.

The "Hybrid Transistor Diode Logic" (HTDL) circuit technique employs either diodes or emitter follower transistors as gates and buffers, to maximize the circuit performance rating.

THE DESIGN OF DIODE-TRANSISTOR NOR CIRCUITS
D.P. Masher, IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, 15/24.

. . . adoption of diode-transistor NOR circuitry for a moderately fast data-processing system are outlined. The design of the basic circuit is treated in detail. . . .

TRANSISTOR LOGIC CIRCUITS (39-S)
R.B. Hurley, New York, John Wiley & Sons, Inc., 1961, 363 p.

CURRENT-OPERATED DIODE LOGIC GATES
H. Reinecke, Jr., Commun. and Electronics, vol. 79, no. 52, Jan. 1961, p. 762/772.

The literature contains many articles on the design of voltage-operated diode logic gates. . . . major disadvantage . . . restriction of the design to two or three stages . . . This paper formulates the general realization procedures applicable to the synthesis of current-operated diode logic networks. . . . is essentially the dual of the voltage-operated gate . . . A static multiplier capable of simultaneously multiplying two 4-bit binary numbers was designed employing current-operated techniques exclusively. . . .

Related Publications:

ANALOG AND THRESHOLD BUILDING BLOCKS FOR VARIABLE-RADIX ADDERS AND OTHER LOGIC
J. Sklansky, Commun. and Electronics, vol. 80, no. 55, July 1961, p. 289/295.

A system of "TKM" logic, based on 3-state threshold devices, Kirchoff adders (i.e., summing amplifiers), and linear amplifiers is proposed. It is shown that TKM logic can realize any multiple-valued truth table, and that the length of the alphabet of truth values may be arbitrary. This logic is shown to be particularly well suited to the synthesis of variable-radix adders . . .

PULSE COUNTING AND FAST SCALING TRANSISTOR CIRCUITS
F.H. Wells, et al., J. Brit. Instn. Radio Engrs., vol. 23, no. 3, March 1962, p. 231/235.

The present state of fast transistor scaling circuits is reviewed and typical designs given for: (1) a frequency divider stage for regular pulses; (2) a periodic binary circuits for both slow and fast (100 Mc/s p.r.f.) operation; (3) modification of a 4 binary scale-of-16 to a decade scaler operating at 10 Mc/s; (4) general purpose bistable pulse and gates circuits for use in pulse data processing applications as an add and subtract binary scaler or alternatively for gating pulse timing trains up to 8 Mc/s repetition rates. The present maximum repetitive pulse counting rates of scalar design is about 200 Mc/s but these rates may be exceeded with the use of faster transistors or tunnel diode circuits. . . .

HIGH-SPEED TRANSISTOR-TUNNEL-DIODE SEQUENTIAL CIRCUITS
J.J. Amodei, et al., RCA Rev., vol. 24, no. 3, Sept. 1963, p. 355/380.

. . . paper describes some register, counter, and shift-register configurations for operation at high repetition rates. The results show that operation of any of these circuits at clock rates between 100 and 200 mc can be achieved reliably under realistic conditions and using commercially available components . . .

3A.224: Tunnel Diode Logic Circuits

Included: Esaki's diode logic circuits; Bias-controlled tunnel-pair logic circuits; Balanced-pair tunnel diode circuit; Tunnel diode balanced-pair logic system.

Not Included: Tunnel diode development.

Cross References: Tunnel diode memory units (3A.267).

Principal Publications:

TUNNEL DIODE LOGIC CIRCUITS
R.H. Bergman, IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 430/438.

. . . a monostable type of logical circuit. The switching properties of this circuit are analyzed and found to depend upon the negative resistance - capacitance time constant of the unit.

TUNNEL DIODE DIGITAL CIRCUITRY
W.F. Chow, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 295/301.

. . . In the first part, the basic tunnel diode logic circuits are discussed. These include the monostable and the bistable analog-threshold gates and the "Goto-pair," which uses the principle of majority decision.
In the second part, a tunnel diode flip-flop stage which has advantages with respect to speed, ease of operation and component tolerances is described. Combination of these flip-flops in counter and shift-register configurations have been successfully operated. Several potential advantages over conventional transistor circuits are discussed.

ESAKI DIODE HIGH-SPEED LOGICAL CIRCUITS
E. Goto, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 25/29.

. . . based on a principle similar to parametron (subharmonic oscillator element) circuits . . . Two diodes are used in series to form a basic element called a twin, and a binary digit is represented by the polarity of the potential induced at the middle point of the twin, which is controlled by the majority of input signals applied to the middle point. Unilateral transmission of information in circuits consisting of cascaded twins is achieved by dividing the twins into three groups and by energizing each group one after another in a cyclic manner. Experimental results with the clock frequency as high as 30 mc are reported.

HIGH-SPEED LOGIC CIRCUITS USING COMMON-BASE TRANSISTORS AND TUNNEL DIODES
J. Amodei, et al., RCA Rev., vol. 22, no. 4, Dec. 1961, p. 669/684.

GRAPHICAL ANALYSIS OF TUNNEL-DIODE PULSE CIRCUITS
J.J. Hill, Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 170.

ESAKI DIODE NOT-OR LOGIC CIRCUITS
H.S. Yourke, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 183/190.

Two embodiments of the basic scheme are discussed, which, when combined with an OR-DELAY circuit, provide a logically complete system.

SOME NEW HIGH-SPEED TUNNEL-DIODE LOGIC CIRCUITS
M.S. Axelrod, et al., IBM J. Res. Developm., vol. 6, April 1962, p. 158/169.

. . . describes two interesting variations of the "Goto pair" majority logic circuit and makes certain claims as to their superiority over other types of tunnel diode logic circuits. The circuits are analyzed by simulation with both analog and digital computers; powerful techniques to aid in circuit development and design where sufficiently accurate high frequency models of the active elements are available. Results of laboratory tests of small groups of circuits are given and actual component values used are specified.

BIAS-CONTROLLED TUNNEL-PAIR LOGIC CIRCUITS
W.N. Carr, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 6, Dec. 1962, p. 773/779.

A three-terminal network consisting of two matched tunnel diodes and a fixed resistor is introduced as a basic element for performing peak threshold summation logic.

AN ANALYSIS OF THE EFFECTS OF REACTANCES ON THE PERFORMANCE OF THE TUNNEL-DIODE BALANCED-PAIR LOGIC CIRCUIT
J.J. Gibson, RCA Rev., vol. 23, no. 4, Dec. 1962, p. 457/488.

TUNNEL DIODE LOGIC CIRCUITS
M.R. Haskard, Proc. Instn. Radio Engrs., Australia, vol. 23, no. 3, March 1962, p. 190/193.

. . . results of evaluation tests on tunnel diode logic configurations and components. It includes a number of circuits and results using current components. . . .

TUNNEL-DIODE BALANCED-PAIR SWITCHING ANALYSIS
G.B. Herzog, RCA Rev., vol. 23, no. 2, June 1962, p. 187/214.

. . . Reported diode switching times of less than 0.1 nanosecond led to expectations that tunnel-diode logic circuits could operate at information rates of 1kmc. The use of one tunnel diode as the biasing impedance for a second in a balanced circuit driven by opposite phases of an a-c clock appeared to give increased logic gain with reduced dissipation over that of single-ended bistable circuits with resistor constant-current bias sources. Experimental balanced-pair circuits were operated at 1.2 kmc verifying the fast switching characteristics of tunnel diodes . . .

NOTE ON TUNNEL DIODES FOR MAJORITY LOGIC CIRCUITS
A. Judeinstein, et al., Elect. Commun., vol. 37, no. 4, 1962, p. 398/399.

AN EVALUATION OF TUNNEL-DIODE BALANCED-PAIR LOGIC SYSTEMS
H.S. Miiller, et al., RCA Rev., vol. 23, no. 4, Dec. 1962, p. 489/538.

TUNNEL DIODE PULSE CIRCUITS
S. Stern, System Development Corp., Santa Monica, Calif., Rept. no. SP-902, 25 July 1962, 16 p., incl. illus., 7 refs., AD 288 834.

A survey is given on the application of tunnel diodes to pulse circuits. . . . Analytical and experimental information explaining the characteristics of the device and its use in pulse circuits is included.

AN ANALYSIS OF THE EFFECT OF COMPONENT TOLERANCES ON THE AMPLIFICATION OF THE BALANCED-PAIR TUNNEL-DIODE CIRCUIT
R. Brayton, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 269/274.

. . . to determine . . . the minimum amount of control required when specified parameter imbalances are present in the system. The problem is formulated and the minimum control is determined numerically.
The Goto-pair or balanced-pair tunnel-diode circuit is a bistable device which, when given an input pulse of some sign will give a larger output pulse of the same sign (at a later time), i.e., the pulse is amplified. When combined with a method

(such as majority logic) for performing the necessary logic functions, such a device can be used as a basic building block for a digital computer.

HIGH SPEED LOGIC CIRCUITS USING A TUNNEL DIODE TRANSISTOR FEEDBACK AMPLIFIER
G.G. Scarrott, et al., J. Brit. Instn. Radio Engrs., vol. 26, no. 6, Dec. 1963, p. 485/491.

. . . The necessity for matching active logic elements to a screened transmission system rules against the use of diode-gate transistor amplifer circuits of the type which has become familiar. An amplifier circuit is described which has a virtual-earth input combined with a non-linear response suitable for threshold logic. . . .

SOME PROPERTIES OF THE TUNNEL DIODE BALANCED PAIR CIRCUIT
N.E. Wiseman, J. Brit. Instn. Radio Engrs., vol. 26, no. 6, Dec. 1963, p. 492/494.

. . . has been widely publicized as a potentially very fast computing element. On a very small scale it has been shown to work at more than 1 kMc/s. There are however several aspects of this circuit which make it difficult to use. This paper attempts to expose a few of the problems associated with the balanced pair as it might be used in an actual computing system. Some of these problems have been overcome, others are being investigated and it seems likely that a complete system based on tunnel diodes can be brought into operation in the reasonably near future. . . .

3A.225: Parametrons

Included: Magnetic parametron logic elements; Magnetic film parametrons; Parametron digital computer MUSASINO; Parametron phase-locked oscillator; Capacitive parametron; Thin-film parametrons; High-frequency magnetic film parametron; Non-stationary parametrons; Subharmonic oscillators as parametrons; Transformed parametron; Inductive parametrons.

Not Included: Theory of parametric amplifiers; Phase-lock loops as detectors.

Cross References: Microwave computer technology (3A.213); Magnetic thin-film technology (3A.205).

Principal Publications:

SEMICONDUCTOR DIODES IN PARAMETRIC SUBHARMONIC OSCILLATORS
J. Hilibrand, et al., RCA Rev., vol. 20, no. 2, June 1959, p. 229/253.

In a parametric subharmonic oscillator, a nonlinear reactance element is driven at frequency 2f and give rise to oscillations in a tank circuit tuned to frequency f. The subharmonic oscillations occur in either of two stable phases. This property makes such oscillators suitable for application in binary computers, where their capability is determined mainly by (1) transient response (rise time), and (2) input power required to establish oscillations. . . .

THE PARAMETRON AS A LOGIC DEVICE
O.A. Jorgensen, Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 391/397.

THE PARAMETRON DIGITAL COMPUTER MUSASINO-1
S. Muroga, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 308/316.

Features of a large-scale digital computer with novel logical elements, the parametrons, are described. . . .

PARAMETRIC PHASE-LOCKED OSCILLATOR — CHARACTERISTICS AND APPLICATIONS TO DIGITAL SYSTEMS
L.S. Onyshkevych, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 277/286.

The ability of the Parametric Phase-Locked Oscillator (PLO) to detect, amplify, and store binary signals, in the form of two distinct phases of a carrier, makes it possible to use the device as the sole component in a digital computer system. The variable-capacitance version of the device operates readily at kilo-megacycle frequencies, thus forming the basis of a digital computer at a kilomegapulse clock rate.

HIGH FREQUENCY MAGNETIC FILM PARAMETRONS FOR COMPUTER LOGIC
A.V. Pohm, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 202/214.

. . . (phase locked subharmonic oscillators) . . . The pump field was applied parallel to the rest direction . . . using about a 14.5 Mc (megacycles per second) pump frequency . . . Calculations show that operation above 100 Mc is possible using permalloy films.

TRANSFORMERED PARAMETRON (In Japanese)
K. Habara, et al., J. Inst. Elect. Commun. Engrs. Japan, vol. 43, no. 9, Sept. 1960, p. 965/970.

NON-STATIONARY PARAMETRONS
K. Onose, Ref. Elect. Commun. Lab., vol. 8, no. 5-6, May/June 1960, p. 204/210.

For the purposes of address selection, the use of parametrons whose oscillation is non-stationary is necessary. A non-stationary exciting system was tried for this purpose, but difficulty was encountered in the adjustment of the amplitude and phase of the exciting current. To counteract this difficulity, d.c.-controlled and diode-controlled parametrons were designed and tested. . . .

SOME APPLICATIONS OF MAGNETIC FILM PARAMETRONS AS LOGICAL DEVICES
R.F. Schauer, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 315/320.

High-frequency magnetic film parametrons have been made and observed to exhibit two- or three-state operation for a single bias condition. As a two-stable-state device, the magnetic film parametron can be used as a majority decision element in much the same way as the ferrit core parametron. Another useful logical two-state device is a threshold element, in which the input excitation must reach a minimum level to sustain oscillations. The magnetic film inductor, when suitably clocked, can be used as a gate to permit unilateral flow of information in a system.

THE DYNAMICS OF A SUBHARMONIC OSCILLATOR WITH LINEAR DISSIPATION
G.J. Lasher, IBM J. Res. Developm., vol. 5, no. 2, April 1961, p. 157/161.

A mathematical analysis of the dynamic behavior of subharmonic oscillators (parametrons) is made assuming a nonlinear reactance but a linear dissipation or resistance. Simple equations of motion for the subharmonic and pump amplitudes are derived in the quasistatic, or high Q, approximation. . . .

RELAXATION OSCILLATIONS AT MULTIPLE FREQUENCIES OF EVEN SUBHARMONICS
N.S. Prywes, Commun. and Electronics, vol. 80, no. 53, March 1961, p. 48/52.

. . . offers a method of analysis for a parametric amplifier circuit. The circuit, composed of nonlinear inductance for parametric excitation, is designed to operate at one-half of the pump frequency. The Parametron has proved useful as a general-purpose element for digital computers, having the potential capability of logic, storage, and amplification. . . .

MAGNETIC PARAMETRON LOGIC ELEMENTS
S.N. Einhorn, et al., Burroughs Corp., Philadelphia, Pa., Quarterly progress rept. no. 3, 1 Oct. 1962-31 Dec. 1962, 31 Dec. 1962, 29 p., AD 401 243.

PARAMETRONS (Translated from Japanese and English into Russian)
Moscow, IIL, 1962, 332 p.

The parametron, invented by the Japanese scientist Goto, is a new type of memory for computer circuits. Due to its simple construction and operational reliability, it successfully replaces complex and cumbersome electron-tube circuits. The book contains papers by eminent Japanese specialists published in the Japanese technical literature in recent years. . . . main trends of the investigations of Japanese scientists and engineers . . .

AN EXPERIMENTAL INVESTIGATION INTO THE OPERATION OF THE PARAMETRIC PHASE-LOCKED OSCILLATOR
K.W. Beer, J. Brit. Inst. Radio Engrs., vol. 25, no. 5, May 1963, p. 432/440, 25 refs.

. . . The time required for maximum build-up of oscillation is shown to be reduced by increasing (1) the pump voltage, (2) the phase-initiating voltage and (3) the Q of the resonant circuit. . . . practical applications . . . including the use of the device for logical circuitry. . . . experimental investigation . . . on the "parametron" or "phase-locked oscillator". . . .

MAGNETIC PARAMETRON LOGIC ELEMENTS
S.N. Einhorn, et al., Burroughs Corp., Paoli, Pa., First Quarterly Progress Report, 1 April-30 June 1963, 75 p., N63-21866.

The design of a 128-word RF nondestructive memory, compatible with Parametrons, is described . . .

ON THE CHARACTERISTICS OF CYLINDRICAL THIN-FILM PARAMETRONS PUMPED TO SATURATION (Correspondence)
B.A. Kaufman, et al., Proc. IEEE, vol. 51, no. 5, May 1963, p. 855/856.

ANALYSIS OF OPERATION OF CAPACTIVE PARAMETRON
G.I. Rassokhin, Joint Publications Research Service, Washington, D.C., In its News of Higher Educational Inst., Min. of Higher and Secondary Specialized Educ., USSR, Radio Eng. Ser., 4 Dec. 1963, p. 48/74, refs., N64-12729.

. . . is widely used in computational technology . . . makes it possible to operate at very high frequencies . . . Account is taken of the influence exerted on the characteristics of the parametron by the forward conductivity of the diode, which determines the damping of the parametric resonant circuit.

DESIGN AND CALCULATION OF INDUCTIVE PARAMETRONS
V.A. Sokolov, Joint Publications Research Service, Washington, D.C., In its News of Higher Educational Inst. Min. of High and Secondary Specialized Educ., USSR, Radio Eng. Ser., 4 Dec. 1963, p. 75/97, refs., N64-12730.

. . . main theoretical premises . . . parametrons using ferrite cores . . .

SWITCHING APPLICATION FOR THE PARAMETRON
G.W. Thomas, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 149/150.

This paper deals with the application to Military Switching of a highly reliable logic element called a "parametron". . . .

Related Publications:

SEMICONDUCTOR PARAMETRIC DIODES IN MICROWAVE COMPUTERS
J. Hilibrand, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 287/297.

The parametric subharmonic oscillator operates by energy transfer from the pump frequency to the oscillator frequency through a nonlinear energy storage element — in the present case, the nonlinear capacitance of a semiconductor diode. This paper examines both the requirements on the diode for satisfactory performance in this circuit and the limitations on oscillator performance which arise from the nature of the semiconductor diode.

BASES FOR THE CONSTRUCTION OF DIGITAL SUPER-HIGH FREQUENCY AUTOMATIC SYSTEMS
M.S. Neiman, Radio Engng: Transl. of Radiotekhnika, vol. 15, no. 10, 1960, p. 1/11.

. . . study is made of some of the principal questions involved in the construction of digital amplitude, frequency, phase and mixed automatic s.h.f. systems . . .

MAGNETIC PARAMETRON LOGIC ELEMENTS
S.N. Einhorn, et al., Burroughs Corp., Philadelphia, Pa., Quarterly progress rept. no. 2, 1 July-30 Sept. 1962, 30 Sept. 1962, 63 p., incl. illus. tables, AD 291 640.

RESEARCH ON PARAMETRON STORAGE AND CONTROL UNITS FOR A SWITCHING OFFICE
L. Stambler, et al., RCA Defense Electronic Products, New York, Final rept., 1 Oct. 1960-10 April 1962, on An Investigation Leading to the Design of a Parametron Switchboard, Rept. no. CR-61-419-3G, 31 May 1962, 178 p., incl. illus. tables, AD 276 367.

. . . design effort on an automatic switchboard using parametrons in the control circuitry. The switchboard design also contains solid state crosspoints and a transistorized power supply . . . breadboards, representing fundamental switchboard circuitry, illustrate in addition to feasibility the potential miniaturization and reliability of the system.

MAGNETIC PARAMETRON LOGIC ELEMENTS
S.N. Einhorn, et al., Burroughs Corp., Philadelphia, Pa., Quarterly progress rept. no. 1, 1 April-30 June 1963, 70 p., AD 418 035.

A 128 Word, r-f, nondestructive memory compatible with Parametrons is being designed . . . Improved r-f pump amplifiers were designed and constructed. As part of the system study to compare Parametrons with conventional logic elements, logic equations have been derived for the arithmetic section of a digital computer.

MAGNETIC PARAMETRON LOGIC ELEMENTS
S.N. Einhorn, et al., Burroughs Corp., Philadelphia, Pa., Quarterly progress rept. no. 4, 1 Jan. 1961-March 1963, 26 p., AD 408 126.

. . . development of advanced Parametron elements, configurations, circuit arrangements, and modes of operation suited to perform logic functions in data processing sub-systems . . . Vacuum deposited resistors and capacitors suitable 50 Mc (pump) Parametrons were successfully fabricated . . .

3A.226: All-magnetic Logics

Included: Diodeless magnetic core logic circuits; Magnetic analogs of relay contact networks.

Not Included: Theory of magnetic devices; Magneto physics.

Cross References: Core memories (3A.264); Shift registers (3A.25).

Principal Publications:

ANALYSIS OF TRL CIRCUIT PROPAGATION DELAY
W. J. Dunnet, et al., Proc. Eastern Joint Comp. Conf., Dec. 1958, p. 99/108.

Experimental and analytical investigations . . . Propagation delay is the time required, after the application or removal of an input signal, for the TRL transistor output level to begin to change. Transistor input capacity; transistor rise, decay and storage times; and their relationship to propagation delay are discussed.

THE LADDIC—A MAGNETIC DEVICE FOR PERFORMING LOGIC
U. F. Gianola, et al., Bell. Syst. Tech. J., vol. 38, no. 1, Jan. 1959, p. 45/72.

. . . is a ladder-like structure cut out of a rectangular hysteresisloop ferrite.

MAGNETIC ANALOGS OF RELAY CONTACT NETWORKS FOR LOGIC
D. B. Armstrong, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 30/35.

Two techniques are described for designing multi-apertured magnetic structures capable of realizing any specific logic function. . . .

SEQUENCE DETECTION USING ALL-MAGNETIC CIRCUITS
H. D. Crane, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 155/160.

A technique is described for detecting specific sequences of pulses occurring on a net of input lines. This technique lends itself to realization in all-magnetic networks by the use of multi-aperture magnetic devices (MAD's). . . . Processing rates in excess of 100,000 characters per second may be achieved. . . . One example involves a system for detecting handwritten characters . . . The second example relates to the . . . detection of specific words (letter sequences) and phrases (series of sequences).

DIGITAL APPLICATIONS OF MAGNETIC DEVICES
A. J. Meyerhoff, Sr. (Editor), New York, John Wiley & Sons, Inc., 1960, 623 p.

. . . material which was only available scattered throughout a large number of technical journals and convention records.

A BIBLIOGRAPHICAL SKETCH OF ALL-MAGNETIC LOGIC SCHEMES
D. R. Bennion, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 203/206.

. . . Included are: 1) schemes using electric-circuit transfer linkage with simple cores, multipath cores, and thin-film elements, and 2) schemes using continuous magnetic structures where transfer linkage is purely magnetic.

DESIGN OF AN ALL-MAGNETIC COMPUTING SYSTEM: PART I — CIRCUIT DESIGN
H. D. Crane, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 207/220.

. . . describes the circuits used in a decimal arithmetic unit which utilizes ferrite magnetic elements and copper conductors only. . . . The sole logical building block of this system is a two-input inclusive-OR module with a fan-out capability of three with any desired logical positive and negative combination. . . .

DESIGN OF AN ALL-MAGNETIC COMPUTING SYSTEM: PART II — LOGICAL DESIGN
H. D. Crane, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 221/232.

. . . the module forms the (inclusive) OR function of two input variables. This function can subsequently be transmitted to three receivers, each transfer being independently logically positive or negative. The read-outs are nondestructive and the transmitter module must be explicitly cleared before read-in is again possible.

MAGNETIC SYSTEMS FOR ORDNANCE AND SPACE APPLICATIONS
S. B. Disson, et al., Proc. Nat. Aerosp. Electronics Conf., vol. 9, May 1961, p. 437/444.

. . . The Bimag technique, developed by Burroughs and applied to numerous data processing systems, is perhaps the most reliable and the most thoroughly analyzed digital magnetic circuit type in the industry . . .

THE USE OF THE COMPLEX ALGORITHM IN THE MECHANIZATION OF BOOLEAN SWITCHING FUNCTION BY MEANS OF MAGNETIC CORES
S. N. Einhorn, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 615/622.

LOGIC CIRCUITS USING SQUARE-LOOP MAGNETIC DEVICES: A SURVEY
J. L. Haynes, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 191/203, 61 refs.

. . . This survey is a capsule view of twenty-four square-loop magnetic logic circuits which have been proposed or developed so far, with a brief description of the way each circuit or circuit family meets the requirements of logic circuitry. . . . consistent terminology, and the generic relationships among circuits are stressed. . . .

A STRAIGHTFORWARD WAY OF GENERATING ALL BOOLEAN FUNCTIONS OF N VARIABLES USING A SINGLE MAGNETIC CIRCUIT
K. V. Mina, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 151/156.

A correspondence has been established between the topology of relay contact networks and the topology of magnetic circuits, which may be applied to a relay tree to produce a magnetic structure capable of generating, in a simple manner, all Boolean functions of N variables.

LINEAR-INPUT LOGIC
R. C. Minnick, IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 6/16.

Techniques are developed for the logical design of magnetic core circuits to produce arbitrary single-output combinational switching functions. The approach is based on the relationship of a single magnetic core circuit to a linearly separable switching function. A synthesis procedure is developed which uses a pair of logical primitives, AND with NOT and OR with NOT, which are similar to the STROKE primitive and its inverse. . . . a table of all four-variable circuits is presented in which no circuit requires more than three cores.

FLUX SWITCHING IN MULTIPATH CORES
D. Nitzan, Stanford Research Inst., Menlo Park, Calif., Rept. no. 1, Nov. 1961, 212 p. incl. illus., 151 refs, AD 275 533.

NETWORK MODELS FOR MAGNETIC-CORE LOGIC CIRCUITS
D. R. Bennion, Stanford Research Inst., Menlo Park, Calif., Technical rept. no. 3, July 1962, p. 94, incl. illus., table, 11 refs., AD 283 124.

DIODELESS MAGNETIC CORE LOGIC CIRCUITS
D. L. Hamilton, Harry Diamond Lab., Washington, D. C., HDL Rept. TR1072, 15 Aug. 1962, p. 50, AD 407 174.

The ability to perform all the basic logic functions associated with memory, and-gates, or-gates, and not-gates by using circuits composed only of square loop magnetic cores and interconnecting wire is reported.

BINARY ARITHMETIC UTILIZING FERRITE CORES
D. J. Morris, et al., Electronic Engng., vol. 34, Jan. 1962, p. 28/33.

The use of ferrite cores in serial-operation logic circuits where the pulses are in time sequence is described. Any one mathematical operation of any number up to 1000 requires 385 μsec.

SQUARE-LOOP FERRITE CIRCUITRY
C. J. Quartly, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1962.

Related Publications:

ALL MAGNETIC SHIFT REGISTER SCHEME STUDIES
E. K. Van De Riet, Stanford Research Inst., Menlo Park, Calif., Technical rept. 4, July 1963, p. 52, AD 416 551.

A method of cataloging and synthesizing all magnetic shift register circuits . . . The cataloging procedure provides the consistent organization of known schemes, and the synthesis process generates all possible shift register schemes in a given category . . .

Section 3A. 23: Analog Functional Circuits

3A. 230: Analog Functional Units

Included: Functional circuits in general; Waveform shaping circuits; Elapsed time computation; D. C. negative resistance in analog computing elements; Frequency domain sampling analog computation.

Cross References: Analog data processing equipment (Div. 3A.5).

Principal Publications:

ELAPSED TIME COMPUTATION
H. W. Abbott, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 195/201.

. . . A number of arithmetic operations using the amplitudes of independently variable electrical quantities are considered . . .
. . . Examples of semiconductor circuits employing the principles of elapsed-time computation are given. These include systems having various combinations of analog and digital inputs and outputs . . .

DESIGN FUNDAMENTALS OF ANALOG COMPUTER COMPONENTS
R. M. Howe, Princeton, N. J., D. Van Nostrand Co., Inc., 1961, 268 p.

FUNCTIONAL CIRCUITS AND OSCILLATORS
H. J. Reich, New York, D. Van Nostrand, 1961, 458 p.

. . . compendium of all kinds of nonlinear circuits . . .

WAVE GENERATION AND SHAPING
L. Strauss, New York, McGraw-Hill Book Co., Inc., 1960, 506 p.

DELAY OF TIME FUNCTIONS BY MEANS OF FREQUENCY DOMAIN SAMPLING
W. W. Wierwille, Commun. and Electronics, vol. 80, no. 59, March 1962, p. 63/65.

. . . particularly amenable to analog computer techniques . . .

USING OF SYNCHROS FOR MATHEMATICAL CALCULATION (In French)
F. Hagen, Onde Electr., vol. 43, no. 434, May 1963, p. 580/583.

A SERIES TYPE D. C. NEGATIVE RESISTANCE FOR ANALOGUE COMPUTERS
P. V. Indiresan, et al., J. Brit. Instn. Radio Engrs., vol. 26, no. 5, Nov. 1963, p. 417/420.

Negative resistances are only conditionally stable, the shunt type when connected to a positive resistance of a smaller value and the series type when the load resistance is larger. Hence, in general, in an electrical resistance analogue, both series and shunt types of negative resistance will be required. . . .

3A.233: Analog Amplifiers

Included: Operational amplifiers; D. C. amplifiers; Magnetic amplifiers; MD-amplifiers; Chopper amplifiers; Transistorized computing amplifiers; Servo amplifiers; Solid state carrier amplifier; Microwave carrier modulation-demodulation amplifier; Self-saturating magnetic amplifiers; Feedback amplifiers; Low-level amplifiers; Differential amplifiers.

Not Included: Wideband amplifier design; Video amplifier design; IF amplifiers.

Cross References: Logarithmic amplifiers (3A. 236); Magnetic amplifiers in analog multipliers (3A.234).

Principal Publications:

INVESTIGATIONS OF MAGNETIC AMPLIFIERS WITH FEEDBACK
H. J. Gray, Jr., IRE Trans. Electronic Comp., vol. EC-7, no. 3, Sept. 1958, p. 213/217.

Sine wave carrier excited magnetic amplifiers have been investigated to determine if the figure of merit can be improved through the use of feedback techniques.

DESIGN CONSIDERATIONS FOR DIRECT-COUPLED TRANSISTOR AMPLIFIERS
J. E. Lindsay, et al., RCA Rev., vol. 19, no. 3, Sept. 1958, p. 433/454.

An outstanding source of difficulty in d-c amplifier design is drift. . . . the procedure to be described is to seek a relationship between the driving source and the amplifier which will yield optimum performance with respect to signal-to-drift ratio. . . .

OPERATIONAL AMPLIFIERS
R. L. Konigsberg, Adv. Electr. El. Phys., vol. 11, 1959, p. 225/287.

MULTILOOP FEEDBACK AMPLIFIERS ANALYSIS
L. M. Vallese, Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 718/726.

. . . the analysis of multiloop feedback amplifiers is reduced to that of a cascade combination of unilateral amplifiers. . . .

A PRECISION AMPLITUDE-DISTRIBUTION AMPLIFIER
W. F. Caldwell, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 252/255.

A new electronic slicer circuit produces output pulses whenever a random input voltage x(t) is between two slicing levels . . . The slicer pulses gate a counter to produce a direct digital readout count equal to the estimated first-order probability density of the input signal. The system was designed for random process studies with conventional electronic analog computers and has compatible accuracy.

A LOW-DRIFT TRANSISTOR CHOPPER-TYPE D. C. AMPLIFIER WITH HIGH GAIN AND LARGE DYNAMIC RANGE
I. C. Hutcheon, et al., Proc. Instn. Elect. Engrs. Pt. B, vol. 107, no. 35, Sept. 1960, p. 451/465.

DC AMPLIFIER MISALIGNMENT IN COMPUTING SYSTEMS
R. L. Konigsberg, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 352/358.

. . . will generalize the concept of the equivalent input circuit representation for dc offset for the four amplifier types with finite input impedances, and will give the conditions under which the use of each equivalent circuit is justified. . . .

SELF-SATURATING MAGNETIC AMPLIFIERS
G. E. Lynn, et al., New York, McGraw Hill Book Co., Inc., 1960, 213 p.

A LOW LEVEL TRANSISTOR D. C. AMPLIFIER
P. A Michaels, Proc. Nat. Telem. Conf., May 1960, p. 715/727.

. . . that could be used as an operational amplifier for small signal applications in the -65° to +85°C temperature range. Since small size was of paramount importance in this application, it was decided not to use a signal chopper or modulator. Instead, a concerted effort was made to stabilize a straight d. c. amplifier.

ANALYSIS AND METHODS FOR DETECTION OF SOME DC AMPLIFIER ERRORS (Correspondence)
C. J. Nisson, IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 121/123.

Tests which permit an operator to check his analog computing equipment in place are of great value, and an effort is being made to increase the amount of information that may be obtained in this manner.

A GENERAL PURPOSE TEN-WATT TRANSISTORIZED SERVO AMPLIFIER
R. R. Atherton, Naval Avionics Facility, Indianapolis, Ind., Technical rept., Rept. no. TR-77, 31 July 1961, 145 p., incl. tables, AD 281 945.

A NEW DESIGN APPROACH FOR FEEDBACK AMPLIFIERS
M. S. Ghausi, et al., IRE Trans. Circuit Theory, vol. CT-8, no. 3, Sept. 1961, p. 274/286.

. . . is based on the root-locus technique. . . . key feature of the root-locus technique is the proper use and location of phantom zeros (transmission zeros of the feedback path).

DIRECT-COUPLED SELECTIVE TRANSISTOR RC AMPLIFIERS
Y. I. Kuflevskiy, Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 9, 1961, p. 23/33.

. . . with two DC-coupled transistors, containing a tuned twin-T bridge in the negative feedback circuit. . . .

AMPLITUDE DISTORTION IN TRANSISTOR FEEDBACK AMPLIFIERS
J. H. Mulligan, Jr., Commun. and Electronics, vol. 80, no. 55, July 1961, p. 326/335.

OPERATIONAL AMPLIFIERS USING CONTROLLED SUPERCONDUCTORS
P. M. Chirlian, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. p. 6/9.

The use of controlled superconductors in analog-computer circuitry is discussed. It is shown that the operations of summation, multiplication by a constant, differentiation, integration, and multiplication of two variables may be performed by these circuits.

MICROWAVE-CARRIER MODULATION-DEMODULATION AMPLIFIERS AND LOGIC CIRCUITS
W. Eckhardt, et al., Proc. IRE, vol. 50, Feb. 1962, p. 148/162.

. . . four-terminal unidirectional amplifiers in which amplitude modulators with conversion gain are followed by demodulators. This paper describes wideband video M-D amplifiers . . . and ultra-high-speed M-D logic circuits . . . The wideband video M-D amplifier is analyzed and satisfactory agreement between theory and experiment is obtained.

A NEW FEEDBACK BROADBANDING TECHNIQUE FOR TRANSISTOR AMPLIFIERS
M. S. Ghausi, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 127/140.

FUNDAMENTALS OF MAGANETIC AMPLIFIERS
B. Kemp, Indiana, Howard W. Sams and Co., Inc., 1962, 128 p.

MAGNETIC AMPLIFIER ANALYSIS
D. L. Lafuze, John Wiley and Sons, Inc., New York, 1962, 252 p.

LOW-FREQUENCY TRANSISTOR AMPLIFIERS WITH DIRECTLY COUPLED STAGES AND DC FEEDBACK
V. I. Anisimov, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 3, March 1963, p. 63/69.

MAGNETIC AMPLIFIERS (Translation from English to Russian)
G. Attura, Moscow-Leningrad, Gosenergoizdat, 1963, 288 p.

. . . theory of modern magnetic amplifiers, namely the saturation choke and the self-saturation amplifier. . . .

DEVELOPMENT OF A SOLID-STATE CARRIER AMPLIFIER FOR USE IN AEROSPACE INSTRUMENTATION
M. H. Brogden, et al., IEEE Paper no. 63-290, Feb. 1963, 10 p.

. . . The output of transducers which convert such parameters as force, pressure and strain, etc. into a modulated 20 KC carrier is amplified by these instruments. Demodulation is provided to convert the modulated carrier signal into a DC output current to drive galvanometer recorders, giving a permanent record of the variable being measured. . . .

AN ENGINEERING APPROACH TO THE DESIGN OF TRANSISTOR FEEDBACK AMPLIFIERS
E. M. Cherry, J. Brit. Instn. Radio Engrs., vol. 25, no. 2, Feb. 1963, p. 127/144.

A technique is developed for the design of transistor feedback amplifiers, based on the use of impedance mismatches between stages. . . .

NOTE ON A REVIEW OF "OPERATIONAL AMPLIFIERS USING CONTROLLED SUPERCONDUCTORS" (Correspondence)
P. M. Chirlian, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 137.

A REVIEW OF CHOPPER AMPLIFIERS
P. F. Howden, Electro-Technology, vol. 71, June 1963, p. 64/67, A63-20713.

PERFORANCE OF OPERATIONAL AMPLIFIERS WITH ELECTRONIC MODE SWITCHING
G. A. Korn, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 310/312.

The linear-circuit performance equation for an important class of mode-switched operational amplifiers is derived to identify errors caused by finite feedback loop gains, switch resistance, and follower-amplifier source impedance.

DIFFERENTIAL AMPLIFIERS
R. D. Middlebrook, New York, John Wiley and Sons, Inc., 1963, 115 p.

. . . gives special attention to differential d-c amplifiers. . . . presents the design engineer with the difficulties inherent in both differential and d-c amplifiers. The properties of both vacuum tube and transistor types are successfully correlated and carefully analyzed. . . .

MAGNETIC AMPLIFIERS AND MODULATORS (In Russian)
M. A. Rozenblat, Moscow-Leningrad, Gosenergoizdat, 1963, 112 p.

. . . considers single-ended and push-pull magnetic amplifiers without feedback or self-saturation, as well as magnetic modulators. . . . basic design principles . . . physical laws underlying the processes . . . Simplified methods of calculation . . .

MATRIX ANALYSIS APPLIED TO TRANSISTOR AMPLIFIER DESIGN
G. Zelinger, J. Brit. Instn. Radio Engrs., vol. 25, no. 2, Feb. 1963, p. 107/112.

. . . The amplifier is treated in terms of h-parameters and the generalized matrix combines passive input and output terminating networks. . . .

Related Publications:

A VIDEO AMPLIFIER WITH A 30 MC BANDWIDTH
W. A. Zins, East Coast Conf. Aeron. Navig. Electronics, vol. 5, Oct. 1958, p. 213/217.

ANALYSIS OF TRANSISTOR DISTRIBUTED AMPLIFIERS
D. O Pederson, et al., Electronics Research Lab., U. of Calif., Berkeley, Rept. no. 115, 1 Sept. 1960, 28 p., incl. illus., AD 246 172

THE CORRECTION OF FREQUENCY CURVES FOR WIDE BAND AMPLIFIERS BY MEANS OF FEEDBACK
L. B. Ustinova, et al., Radio Engng: Transl. of Radiotekhnika, vol. 15, no. 6, 1960, p. 35/50.

WIDEBAND AMPLIFIER USING BTL M2107 MICROWAVE TRANSISTOR
G. E. Hambleton, Army Signal Research and Development Lab., Fort Monmouth, N. J., ASRDL technical rept. no. 2259, Dec. 1961, 16 p., incl. illus., AD 277 596.

An evaluation was made of the M2107 microwave transistors (first models) as wideband amplifiers . . . Presented in graph form are power gain and noise figure measurements as a function of frequency. The M2107 is a diffused base PNP germanium transistor, with a mesa structure, designed for use as an amplifier at 3000 mc . . . The M2107 microwave transistor operated as an untuned, wideband amplifier (i.e., amplification of electrical signals at frequencies from zero to 1000 mc) . . .

VIDEOFREQUENCY AMPLIFIERS (In Russian)
O. B. Lur'ye, Moscow, Sovetskoye Radio Press, 1961, 676 p.

. . . The frequency and time methods of analysis are explained. The operation of the circuits used most is analyzed: the circuit to fix the initial signal levels, the antinoise correction circuits, etc. . . .

TRANSISTOR STAGE WITH COMBINED FEEDBACK
N. S. Nikolayenko, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 10, Oct. 1963, p. 28/33.

A transistor amplifier stage with both series-type negative feedback and shunt-type position feedback is analyzed. Formulas for calculating the operating conditions and gain are presented and their region of applicability is pointed out. . . .

3A.234: Analog Multipliers and Dividers

Included: Hall effect multipliers; Hall generator in analog multipliers; Magnetic amplifiers in multiplying circuits; Four quadrant time-division multiplier; Electro-mechanical analog multiplier; Analog division circuits.

Not Included: Frequency multipliers; Frequency dividers.

Cross References: Digital multiplication methods (3A.240); Magnetic amplifiers as analog devices (3A.233).

Principal Publications:

ANALOGUE MULTIPLIER BASED ON THE HALL EFFECT
L. Lofgren, J. Appl. Phys., vol. 29, Feb. 1958, p. 158/166.

DIE VERWENDUNG VON HALL-GENERATOREN IN ANALOGMULTIPLIKATOREN (The Application of Hall Generators in Analog Multipliers) (In German)
J. Oxenius, Nachrichtentech. Z., vol. 11, May 1958, p. 263/268.

A TRANSISTORIZED FOUR-QUADRANT TIME-DIVISION MULTIPLIER WITH AN ACCURACY OF 0.1 PER CENT
H. Schmid, IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 41/47.

. . . The circuit is independent of the transistor characteristics, requires no complicated balancing adjustments, exhibits excellent stability and uses only simple, noncritical circuitry. The maximum output voltage is 10 v when both input voltages are 10 v. . . .

WIRKUNGSWEISE UND AUFBAU VON ELEKTROMECHANISCHEM ANALOG-MULTIPLIKATOREN (Operation and Design of Electromechanical Analog Multipliers) (In German)
Elektronische Rundschau, 1958, vol. 9, p. 307/308.

A FOUR-QUADRANT MULTIPLIER USING TRIANGULAR WAVES, DIODES, RESISTORS, AND OPERATIONAL AMPLIFIERS
P. E. Pfeiffer, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 222/227.

A simple scheme of switching triangular waves and measuring the average current through resistors into a low impedance summing point makes possible four-quadrant multiplication with four diodes, precisely adjusted resistors, and a means of measuring the current.

The amplifiers are not required to handle the triangular wave frequencies.

ANALOG DIVISION CIRCUIT
W. McMurray, Electrical Engng., vol. 79, no. 4, April 1960, p. 287.

AN ACCURATE ANALOG MULTIPLIER AND DIVIDER
E. Kettel, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 269/272.

In the time-division multiplier the product $x_1 \cdot x_2$ is formed by pulse-duration modulation with x_1 and amplitude modulation with x_2. The circuit can be arranged in such a manner that division by means of a quantity x_3 can be carried out simultaneously, the output being $x_1 \cdot x_2/x_3$.

THE HALL-EFFECT ANALOG MULTIPLIER
G. Kovatch, et al., IRE Trans. Electronic Comp., EC-10, no. 3, Sept. 1961, p. 512/515.

The application of the Hall effect to a general-purpose four-quadrant multiplier is discussed. Circuit diagrams for the transistor amplifiers are given. An evaluation of the experimental results is given for a breadboard model of the multiplier. Bandwidths of 25 kc and 1.3 kc are achieved for the Hall channel and the magnetic channel, respectively.

SURVEY AND CLASSIFICATION OF MULTIPLYING DEVICES
A. A. Masalov, Automat. Remote Control, vol. 21, April 1961, p. 1000/1051.

AN ANALOG MULTIPLIER USING TWO FIELD EFFECT TRANSISTORS
W. E. Highleyman, et al., IRE Trans. Commun. Syst., vol. CS-10, no. 3, Sept. 1962, p. 311/317.

ANALOG DIVISION BY THE LINEAR CHARGING OF A CAPACITANCE
L. Y. Il'nitskiy, Radio Engng: Transl. of Radiotekhnika, vol. 17, no. 4, April 1962, p. 11/16.

A new method is described of analog division by a circuit of open loop type. The method is based on obtaining a sawtooth voltage for which the rate of change in voltage and frequency is directly proportional to the control voltages. The errors of the division unit and the results of an experiment are presented. . . .

A TIME-DIVISION ANALOGUE MULTIPLIER FOR CORRELATION MEASUREMENTS AND MIXING AT FREQUENCIES UP TO 100 KILOCYCLES PER SECOND
R. F. Johnson, Aeronautical Research Council (Gt. Brit.), 1963, p. 33, refs., N64-14130.

. . . capable of accepting signals from zero frequency to 100 kc/s. Preamplifiers and associated circuits are described that enable the multiplier to be used for the measurement of a wide range of parameters encountered in the turbulence and noise field . . .

TWO FOUR-QUADRANT ELECTRONIC MULTIPLIERS
A. Kraicer, J. Brit. Instn. Radio Engrs., vol. 25, no. 1, Jan. 1963, p. 5/11.

. . . principle used in the first multiplier is that of varying the saturation point of a ferromagnetic circuit in proportion to one of the inputs, so as to control the mark/space ratio of a chopper, which then modulates the other input. . . . The second multiplier uses the principle of modulating the phase of one square wave with respect to another similar wave in proportion to one of the input signals. Zero modulation corresponds to a phase difference of pi/2. This wave then chopper modulates the other input signal, and the resultant output is combined with the original square wave in a synchronous demodulator. . . .

A PULSE MODULATOR THAT CAN BE USED AS AN AMPLIFIER, MULTIPLIER, OR A DIVIDER
J. A. Rozenthal, California U., Berkeley, Lawrence Radiation Lab., MS Thesis, 2 April 1963, 55 p., 9 refs., N63-18814

. . . it can respond without delay to a change in input signal and . . . it is of very simple construction. It can also be used to control either proportional or on-off systems.

DEVELOPMENT OF AN ANALOG MULTIPLIER, BASED ON THE HALL EFFECT
Battelle Memorial Inst., Columbus, Ohio, AMRL TDR63 50, April 1959-April 1963, 75 p. 10 refs., AD 410 897, N63-18898.

The development is described of fabrication techniques for construction of a silicon Hall effect element with characteristics suitable for application in an analog multiplier. The relative merits of various semiconductor materials are considered, and the reasons for the selection of silicon are outlined . . . Approximately 24 successful silicon elements were processed, and three pairs were mounted in suitable magnetic structures . . .

Related Publications:

A CORRELATOR EMPLOYING HALL MULTIPLIERS APPLIED TO THE ANALYSIS OF VOCODER CONTROL SIGNALS
A. R. Billings, et al., Proc. Instn. Elect. Engrs., Pt. B., vol. 107, no. 35, Sept. 1960, p. 435/438.

ZEITSTEUERUNG IM TIROS I (Timing in Tiros I) (In German)
J. Genannt, Flug-Revue, vol. 1, Jan. 1964, p. 23/25, A64-13599.

Discussion of the INCREMAG unit installed in Tiros I, which uses the principle of stepwise magnetization of a core with a roughly rectangular hysteresis loop to divide an 18-kc oscillator frequency to a frequency of 0.5 cps. The transistor circuit and functioning sequency of the device are described.

ANALOG SIGNAL MULTIPLIER
O. S. Meixell, Elect. Commun., vol. 38, no. 4, 1963, p. 443/456.

3A.235: Analog Integrators and Differentiators

Included: Positive feedback differentiators; Wide-band electronic integrator; Logarithmic integrator circuit; Saturable-core modulation integrator; Operational integrators.

Not Included: Plane meter and other geometrical integration instruments.

Cross References: Digital integration methods (3A.182).

Principal Publications:

H-F WIDE BAND ELECTRONIC INTEGRATOR DESIGN
H. Hodara, Electronic Industr., Sept. 1958, p. 96/100.

. . . compensating scheme for two types of integrators that completely eliminates the distortion caused by the output tube capacity . . .

A SIMPLIFIED LOGARITHMIC INTEGRATOR CIRCUIT
H. E. De Bolt, IRE Trans. Nuclear Sci., vol. NS-6, no. 2, June 1959, p. 74/77.

AN ANALOG R-C INTEGRATOR WITH A DIGITAL OUTPUT
R. J. Jarrett, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 611/618.

In inertial guidance systems, one of the critical components is the integrator used to integrate the accelerometer output to produce velocity. In addition to the need for increased integration accuracy, it is extremely desirable to obtain an output in a form that can be directly applied to a digital computer. . . .

A NEW TECHNIQUE FOR ANALOG INTEGRATION AND DIFFERENTIATION
M. A. Thomae, IRE Trans. Electronics Comp., vol. EC-9, no. 4, Dec. 1960, p. 507/509.

A technique is described which enables an approach to ideal analog integration or differentiation by means of passive elements only. A series of RC circuits in a cascade arrangement, uncoupled to each other, provides the first, second, third, etc., integrals or derivatives . . .

A SATURABLE-CORE MODULATION INTEGRATOR
R. C. Barker, et al., Commun. and Electronics, vol. 80, no. 53, March 1961, p. 13/17.

The circuit discussed in this paper . . . is based on the ability of a saturable-core reactor to convert a voltage integral to a magnetic flux and store it until called for. The experimental circuit is an integrator with a direct voltage gain of approximately 100 and a time constant of 4 seconds. . . .

A POSITIVE FEEDBACK DIFFERENTIATOR
L. Y. Il'nitskiy, Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 9, 1961, p. 38/44.

A new type of differentiator with parallel positive feedback is proposed. Circuit analysis is effected on the basis of the generalized voltage noise method. A new differentiator parameter, the Q-factor, is introduced, thus facilitating the comparison and selection of differentiating circuits. . . .

A TRANSISTOR OPERATIONAL INTEGRATOR FOR USE IN ANALOG COMPUTERS
R. D. Ingram, Pennsylvania State U. Coll. of Engineering and Architecture, University Park, 1 June 1962, 37 p., incl. illus., 13 refs., AD 276 298.

3A.236: Special Functional Circuits

Included: Logarithmic operational amplifiers; Square root circuits; Variable gamma amplifier; Wave shaping circuits; Log function generating circuit; Square law circuits; Non-linear interpolators; Aperiodic non-linear amplifiers.

Not Included: Analog and digital function generators; Logarithmic i.f. amplifiers.

Cross References: Magnetic amplifiers (3A.231).

Principal Publications:

A TRANSISTORIZED LOG-VIDEO AMPLIFIER
F. J. Mueller, et al., Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 293/300.

. . . to find . . . solid state devices which will exhibit a linear response to a logarithmic input. . . .

WAVE GENERATION AND SHAPING
L. Strauss, New York, McGraw Hill Book Co., Inc., 1960, 506 p.

Very good review . . . practical . . . all pulse circuitry . . . deflection circuits, etc.

APERIODIC NONLINEAR AMPLIFIER WITH STABLE PASSBAND
G. M. Krylov, Radio Engng: Transl. of Radiotekhnika, vol. 17, no. 9, Sept. 1962, p. 34/39.

. . . Methods for improving the frequency response of nonlinear amplifiers are described. Stabilization of amplifier passband was achieved, in operating over a wide dynamic range of input signal frequencies. . . .

LOGARITHMIC AMPLIFIERS (In Russian)
V. M. Volkov, Kiev, Gostekhnizdat UksrSSR, 1952, 244 p.

. . . theory and design of selective and aperiodic amplifiers with a logarithmic amplitude characteristic . . . transients in aperiodic and selective logarithmic amplifiers . . . fields of application. Practical circuits . . .

SOLID STATE LOGARITHMIC AMPLIFIERS
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 65/67.

ACCURATE LOG AND INVERSE-LOG FUNCTION GENERATING CIRCUITS: FOR USE IN DIGITAL VOCODER PITCH CHANNEL
L. V. Kriger, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 186, June 1963, 66 p., AD 413 479.

A novel synthesis technique, empirical in nature, is developed for diode-resistance function generation circuits attaining accuracies higher than theoretically possible by classic methods of piecewise-linear approximation. . . .

A VARIABLE GAMMA AMPLIFIER (Correspondence)
P. Kundu, Proc. IEEE, vol. 51, no. 5, May 1963, p. 867/868.

. . . non-linear device which yields an output varying directly or inversely as the nth power or root of an input signal, where n may be an integer or a fraction.

SURVEY OF SQUARE LAW DEVICES
J. E. Longfoot, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 5, May 1963, p. 430/439, 20 refs.

A square law device may be considered as being any circuit or component configuration capable of producing an output proportional to the mathematical square of the input. . . . Such devices find wide application in situations where a true rms voltage or current reading is desired, independent of waveform, and in analogue computing where accurate squarers and multipliers are required.

The paper describes some of the uses of squarers and the properties desirable for different applications. . . .

LINEAR AND NONLINEAR INTERPOLATORS
A. Nathan, IEEE Trans. Electron. Computers, vol. EC-12, no. 5, Oct. 1963, p. 526/532.

The function generator is stable as compared with similar nonlinear circuits because its transfer characteristic is independent of the nonlinearity of the resistors in a first spproximation.

A CIRCUIT FOR THE SQUARE ROOT OF THE SUM OF THE SQUARES
T. E. Stern, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 593/596.

A piecewise-linear network . . . using resistors and diodes alone. . . .

A METHOD OF GENERATING FUNCTIONS OF SEVERAL VARIABLES USING ANALOG DIODE LOGIC
R. H. Wilkinson, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 112/129.

A diode-resistor network technique for simulating functions of any number of variables is described. . . . The circuit is formed of two cascaded sections . . .

Related Publications:

THEORETICAL STUDY OF A CLASS OF LOGARITHMICALLY PERIODIC CIRCUITS
R. Mittra, Electrical Engineering Research Lab., U. of Illinois, Urbana, Technical rept. no. 59, July 1962, 25 p. incl. illus, 5 refs., AD 282 847.

Closed-form expressions for lumped Foster type LP circuits were derived. The characteristic equation for an infinite log-periodically-loaded transmission line was derived, and a method of solution of the above equation is discussed. . . .

DESIGN OF A THIN-FILM LOG IF AMPLIFIER
R. Leslie, Rec. Nat. Space Electronics Symp., no. 2.4, 1963.

Section 3A.24

3A.240: Digital Arithmetic Units

Included: Digital division methods; Carry-dependent jam adder; Tunnel diode arithmetic units; Binary adders; Magnetic core parallel adder; Carry-select adder; Table-look-up arithmetic units; Floating point arithmetic units; Two-summand binary adders; Conditional-sum addition logic.

Cross References: Special numeric computation methods (3A.116); Theoretical fundamentals of machine computations (3A.110).

Principal Publications:

A MAGNETIC CORE PARALLEL ADDER
M. Chen, IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 262/264.

A logical design using magnetic core elements which does not have the usual carry time limitations is described. The synthesis uses a truth-table technique.

A NEW CLASS OF DIGITAL DIVISION METHODS
J. E. Robertson, IRE Trans. Electronic Comp., vol. EC-7, no. 3, Sept. 1958, p. 218/222.

. . . best suited for use in digital computers with facilities for floating point arithmetic. The division may be contrasted with conventional division procedures by considering the nature of each quotient digit as generated during the division process.

IMPROVED ARRANGEMENT OF A DECIMAL MULTIPLIER (Correspondence)
J. E. Croy, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 263.

A HIGH SPEED MULTIPLICATION PROCESS FOR DIGITAL COMPUTERS
F. Gurzi, Commun. Assoc. Comp. Mach., vol. 3, April 1960, p. 241/245.

The author proposes a multiplication procedure to achieve a speed to two to three times that of the Booth and Booth method.

FAST HIGH-ACCURACY BINARY PARALLEL ADDITION
H. C. Hendrickson, IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 465/469.

Future designs of parallel digital computers will be concerned with increased accuracy in arithmetic operations. When the number of bits per operand is increased, one basic speed limitation to these operations is the time required to propagate carries in addition or borrows in subtraction. A quantitative method of evaluating the drastic reduction in time achieved by asynchronous addition techniques is described.

A BUILT-IN TABLE LOOK-UP ARITHMETIC UNIT
R. C. Jackson, et al., Proc. Western Joint Comp. Conf., May 1960, p. 239/250.

. . . features the novel combination of a translation-type arithmetic with the translation ability of a random access memory. This system operates serially, taking a single decimal digit at a time from each operand to perform addition, subtraction and multiplication.

TRANSISTOR CURRENT SWITCHING AND ROUTING TECHNIQUES
D. B. Jarvis, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 302/308.

A system of circuit logic is described in which transistors, particularly diffused base transistors, are operated well out of saturation in order to make the most of their speed. . . . application of this system of logic to certain specific computer problems, namely, a parallel adder with a carry propagation time of 40 mμsec over 6 stages, a shifting register capable of operating at 10 mc and a binary decoder with a maximum delay of 40 mμsec.

A NOVEL ADDER-SUBTRACTOR CIRCUIT UTILIZING TUNNEL DIODES
R. A. Kaenel, IRE WESCON Conv. Rec., pt. 3, 1960, p. 53/64.

. . . presents two counter configurations which exploit the properties of a tunnel diode flip-flop. . . . detailed analysis of the circuit . . . published.

A PARALLEL ARITHMETIC UNIT USING A SATURATED-TRANSISTOR FAST-CARRY CIRCUIT
T. Kilburn, et al., Proc. Instn. Elect. Engrs., Pt. B, vol. 107, no. 36, Nov. 1960, p. 573/584.

HIGH SPEED ADDING SYSTEM
N. Kuroyanagi, Rev. Elect. Commun. Lab., vol. 8, no. 3-4, March/April 1960, p. 175/188.

The author proposes a logical circuit designed to speed the addition process in digital computers by obtaining simultaneously the carriers of all digits. . . . Practical circuits and applications of the adder are discussed.

HIGH-SPEED TRANSISTORIZED ADDER FOR A DIGITAL COMPUTER
F. Salter, IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 461/464.

An adder is described that has been developed for the Floating Indexed Point Arithmetic Unit, FLIP, to be used in conjunction with GEORGE, the existing computer built at Argonne National Laboratory.

AN EVALUATION OF SEVERAL TWO-SUMMAND BINARY ADDERS
J. Sklansky, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 213/226.

Five fairly representative members of the class of two-summand binary adders are described and evaluated. . . . evaluated on the basis of three quantities: the number of two-input AND gates and OR gates, G; the gate-normalized addition time, π and the number of bits, n, in each summand.

CONDITIONAL-SUM ADDITION LOGIC
J. Sklansky, IRE Trans. Electronic Comp., vol. EC-9, no. 2, Sept. 1960, p. 226/231.

. . . A rapid-sequence mode of operation provides an addition rate that is invariant with the lengths of the summands. Another advantage is the possibility of realizing the adder with "integrated devices" or "modules."

A 4-MEGACYCLE 24-BIT CHECKED BINARY ADDER
M. E. Homan, Commun. and Electronics, vol. 80, no. 56, Sept. 1961, p. 443/450.

. . . the logical design of a 24-bit binary adder developed for the IBM . . . Stretch computer project is described. . . .

DETERMINATION OF MAXIMUM ERROR OF A BINARY MULTIPLIER
Y. Hsi-zeng, Automat. Remote Control, vol. 21, Feb. 1961, p. 709/713.

SKIP TECHNIQUES FOR HIGH-SPEED CARRY-PROPAGATION IN BINARY ARITHMETIC UNITS
M. Lehman, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 691/698.

. . . The paper discusses and develops the "anticipated-carry" or "carry-skip" techniques originally due in decimal form to Babbage, much used in mechanical calculators and lately revived for use in binary units. Various degrees of refinement are possible. It appears that for a given expenditure, the technique results in a unit which is simpler and faster than those using one of the other techniques.

REDUCING COMPUTING TIME FOR SYNCHRONOUS BINARY DIVISION
R. G. Saltman, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 169/174.

The computing time for binary division is shortened by performing division, radix 2^p on the binary operands, where p is a positive integer. . . . computing time is reduced by approximately the factor p over conventional binary division. The method is most useful for synchronous machines but can be applied to either serial or parallel operation.

ANALOG AND THRESHOLD BUILDING BLOCKS FOR VARIABLE-RADIX ADDERS AND OTHER LOGIC
J. Sklansky, Commun. and Electronics, vol. 80, no. 55, July 1961, p. 289/295.

A system of "TKM" logic, based on 3-state threshold devices, Kirchoff adders (i.e., summing amplifiers), and linear amplifiers is proposed. It is shown that TKM logic can realize any multiple-valued truth table, and that the length of the alphabet of truth values may be arbitrary. This logic is shown to be particularly well suited to the synthesis of variable-radix adders. . . .

THE MANIAC III ARITHMETIC SYSTEM
R. L. Ashenhurst, Proc. A FIPS Spring Joint Computer Conf., May 1962, p. 195/202.

The gross aspects of Maniac III's unusual arithmetic system were made known some time ago as were many of the features of the particular mode of computation termed significant-digit arithmetic. Not until publication of the present paper, however, have most of the important and interesting operational details of this exclusively floating-point system been generally available.

CARRY-SELECT ADDER
O. J. Bedrij, IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 340/346.

A large, extremely fast digital adder with sum selection and multiple-radix carry is described. Boolean expressions for the operation are included. The amount of hardware and the logical delay for a 100-bit ripple-carry adder and a carry-select adder are compared.

A FLOATING POINT ARITHMETIC UNIT
L. J. Bental, Electronic Engng., vol. 34, March, 1962, p. 144/147.

Conversion of the National-Elliott 803 transistorized general purpose digital computer from fixed point binary to floating binary point operation is described.

A DIRECTLY-COUPLED SERIAL ADDER DESIGNED FOR USE IN A DIGITAL DIFFERENTIAL ANALYZER
B. A. Boulter, J. Brit. Instn. Radio Engrs., vol. 23, April 1962, p. 243/252.

A CLASS OF BINARY DIVISIONS YIELDING MINIMALLY REPRESENTED QUOTIENTS
G. Metze, IRE Trans. Electronic Comp., vol. EC-11, no. 6, Dec. 1962, p. 761/764.

Binary division methods employing a redundant quotient representation in which quotient digits assume the values 0, 1, or -1 have been analyzed previously. The method in which partial remainders are always normalized is of particular interest . . . This method is extended to yield minimally represented quotients for all normalized divisors.

COMPUTER MULTIPLICATION AND DIVISION USING BINARY LOGARITHMS
J. N. Mitchell, Jr., et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 512/517.

. . . The logarithm of a binary number may be determined approximately from the number itself by simple shifting and counting. A simple add or subtract and shift operation is all that is required to multiply or divide. . . . An error analysis is given and a means of reducing the error for the multiply operation is shown.

TUNNEL-DIODE FULL BINARY ADDER
C. A. Renton, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 213/217.

A full binary adder utilizing a single tunnel diode and three resistors as its basic components is described . . . Experimental results obtained with a practical circuit that employed a 1N2939 tunnel diode were in good agreement with the analytical findings.

A HIGH-SPEED ARITHMETIC UNIT USING TUNNEL DIODES
W. G. Daly, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 503/511.

. . . utilizes a "sub-multiple algorithm" in both multiplication and division. The organization and circuits, which make the algorithm practical and economical, are presented. . . .

THE CARRY-DEPENDENT SUM ADDER
M. Y. Hsiao, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 265/268.

. . .a checking scheme called "carry-dependent sum add" which is based on the parity prediction method. This scheme assures single-fault detection without duplication of the carry circuit. An example of a binary adder and a decimal adder using this scheme are included.

ON COMPUTER MULTIPLICATION AND DIVISION USING BINARY LOGARITHMS
E. V. Krishnamurthy, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 319/320.

DIVISION USING BINARY LOGARITHMS (Correspondence)
E. V. Krishnamurthy, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963. p. 319/320.

HIGH-SPEED ARITHMETIC EMPLOYING TUNNEL DIODES
H. S. Miiller, RCA Rev., vol. 24, no. 1, March 1963, p. 47/56.

. . . Straight-forward tunnel-diode circuitry was developed which sequentially propagates (and stores) both carries and borrows in parallel adders. Measured stage delays average 0.3 nanosecond . . . worst-case stage delay is 0.4 nanosecond. The power supply for the tunnel-diode circuitry comes from conventional transistor logic circuits. . . .

A NANOSECOND PARALLEL-PARALLEL BINARY ADDER IMPLEMENTED WITH CURRENT MODE LOGIC BUILDING BLOCKS
W. C. Seelbach, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 311/340.

Current mode logic digital circuits offer a great number of advantages for logic implementation. They are extremely fast and insensitive to many device and circuit parameters and provide the complement in addition to the regular output. . . .

A six-bit parallel adder, with look ahead logic scheme for carry generation was implemented, using Motorola MECL current mode logic building blocks. The high speed (3-4 nsec delay per stage) building blocks used in this implementation consisted of three and five input gates, expander modules capable of expanding the three input gate fan-in in increments of 5, half adders, R-S type flip-flops and bias drivers.

Related Publications:

A TRANSISTORIZED DELAY LINE FREQUENCY DIVIDER
S. Rozen, et al., Electronic Engng., vol. 35, Feb. 1963, p. 102/104.

. . . novel . . . circuit based on the use of a delay line as timing element is described. The digital mode of operation is free from the division instabilities associated with analogue frequency dividers due to shifts of supply voltage and discrimination threshold. The division factor can easily be varied by choosing delay lines of different length. Details are given for a decade divider for an input frequency of 2 Mc/s.

Section 3A.25

3A.250: Digital Control Units and Their Components

Included: Shift registers; Magnetic film shift register; Delay line shift register; Diodeless magnetic shift registers; Transfluxor shift registers; Counting devices; Scaling circuits; Binary counters; Glow counting tubes; Cascaded binary counters; Polyatron; Asynchronous counters; Thin film laser counter; Quinary counters; Incremental magnetic counters; Quasi-logarithmic counters; Sheffer stroke logic; Multi-aperture shift register.

Not Included: Lasers (3B).

Cross References: Machine organization of data processors (3A.130); Delay lines as short time buffers (3A.265).

Principal Publications:

DIODELESS MAGNETIC SHIFT REGISTERS UTILIZING TRANSFLUXORS
N. S. Prywes, IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 316/324.

Shift registers using magnetic cores have been conventionally designed with diodes to provide isolation between stages. It is possible to use transfluxors in a two-core-per-bit fashion so as to provide isolation between stages by magnetic means rather than with diodes. A design procedure for doing so is discussed.

A 10-MC TRANSISTORIZED BINARY COUNTER
A. Basil, Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 727/732.

A QUASI-LOGARITHMIC COUNTER
A. Boecker, Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 721/726.

A GLOW COUNTING TUBE READ-OUT TECHNIQUE AND ITS APPLICATION
S. K. Chao, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 317/320.

. . . This paper describes a technique whereby the content of the tube is recognized and read out through a carrier signal applied to the anode and 10 detectors connected to the 10 cathodes. The readout is of the nondestructive type since it does not alter the content of the tube.

ACCURATE DIODE RATE COUNTERS AND SOME APPLICATIONS
J. Collins, East Coast Conf. Aerosp. Navig. Electronics, vol. 6, no. 14.5, Oct. 1959, p. 1/5.

SHIFT-REGISTER CODE FOR INDEXING APPLICATIONS
M. Nadler, et al., Commun. Assoc. Comp. Mach., vol. 2, Oct. 1959, p. 40/43.

There exist at least three different species of codes based on the properties of m sequences. Historically, the first of these codes is the one which uses an m sequence and its cyclic permutations as the code words. Another group of codes uses the m sequence to generate parity checks over a set of binary digits. The crucial property of m sequences used by the authors of this paper is that each 10-bit binary digit (except the all-zero digit) is contained in the sequence once and only once.

A NOTE ON MAGNETIC SHIFT REGISTERS (Correspondence)
D. R. Bennion, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 262.

. . . research . . . at Stanford Res. Inst. on a type of multi-aperture-device shift register employing absorption of flux in coupling-loop resistance during part of the transfer cycle.

THE INSTRUCTION UNIT OF THE IBM STRETCH COMPUTER
R. T. Blosk, Proc. Eastern Joint Comp., Conf. Dec. 1960, p. 299/324.

A THIN MAGNETIC FILM SHIFT REGISTER
K. D. Broadbent, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 321/323.

An initial application of the dynamics and interactions of domains within continuous magnetic thin film structures is made to a shift register in which binary information is stored and translated in and along a continuous evaporated thin magnetic film.

HIGH-SPEED COUNTER REQUIRING NO CARRY PROPAGATION
W. N. Carroll, IBM J. Res. Developm., vol. 4, no. 4, Oct. 1960, p. 423/425.

CONTINUOUS DIFFERENCE COUNTING OF TWO NONSYNCHRONOUS PULSE SERIES (In German)
M. Kalthoff, Elektron. Rundschau, vol. 14, no. 6, June 1960, p. 240/245.

A genuine difference counter . . . in which each decade forms a ring having ten bistable components and which can be operated in forward and backward directions by two separate channels. . . .

CONSTANT-WEIGHT COUNTERS AND DECODING TREES
W. H. Kautz, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 231/244.

A class of computers is described in which the number of 1's in the flip-flops or register stages composing the counter remains constant as the counter advances from state to state. Simple digital circuit arrangements are described for the design of such counters, which may be used with a particular type of decoding tree as economical ring-type counters, to provide a separate output lead for each state.

AN INTEGRATED SEMICONDUCTOR SHIFT REGISTER
J. T. Wallmark, et al., David Sarnoff Research Center, Princeton, N.J., 16 May 1960, AD 240 620.

. . . The packing density of the integrated device, disregarding encapsulation, but including interconnections to other circuits, is approximately 10^8 components per cubic foot.

A MAGNETOSTRICTIVE DELAY-LINE SHIFT REGISTER
L. E. Hargrave, Jr., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 702/708.

. . . A brief theory of correlation, as applied to the recognition of a specific pattern in a binary signal, is presented. The digital shift register, which lends itself well to the practical application of the theory or correlation, is discussed. . . .

A MULTI-PURPOSE COMPUTER ELEMENT
C. B. Taylor, Electronic Engng., vol. 33, Feb. 1961, p. 96/99.

The element described is essentially a long-tailed pair waveform reshaper which, together with a number of logical gates, can have many uses as a basic element for a computing system. The main design aim was to produce an economical binary-counter stage employing transistor-diode logic, but among the many other possible uses of the element are a pulse generator, simple reshaper, bistable delay-element with reshaped biphase outputs running square-wave generator. . . .

COUNTING WITH FEEDBACK SHIFT REGISTERS BY MEANS OF A JUMP TECHNIQUE (Correspondence)
P. R. Bryant, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 285/286.

A TUNNEL-DIODE COUNTER FOR SATELLITE APPLICATIONS
E. G. Bush, NASA, June 1962, 16 p., N62-12755.

CONTROL OF INDUSTRIAL PROCESSES BY ELECTRONIC COUNTING
D. J. Hancock, Proc. Instn. Radio Engrs. Australia, vol. 23, no. 12, Dec. 1962, p. 701/712, 85 refs.

. . . It is shown that electronic counting systems can overcome the disadvantages of mechanical systems and provide facilities not otherwise available. . . . A comprehensive bibliography is included. . . .

THE HIGH SPEED COLLECTOR STEERED QUINARY COUNTER
A. Hemel, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 159/165.

. . . a quinary counter, consisting of 5 inter-related transistors (instead of 2), would be ideal because, in conjunction with a bistable, it would provide 10 combinations. . . . developed a 25 mc quinary counter. . . . mathematical procedures . . . indicated the limits of component values. . . .

A NON-DESTRUCTIVE AND REVERSIBLE BINARY COUNTING CIRCUIT USING FERRITE CORES AND DIODES (In German)
H. B. Liem, et al., Arch. Elekt, Uebertragung, vol. 16, April 1962, p. 189/192.

TUNNEL DIODE SHIFT REGISTER (Correspondence)
B. Rabinovici, Proc. IRE, vol. 50, no. 4, April 1962, p. 473.

DEVELOPMENT OF (PCM) DATA BUFFERS
W. Reymond, Stelma, Inc., Stamford, Conn., Quarterly prog. rept. no. 1, 21 June-23 Oct. 1963, Oct. 1963, 23 p., AD 428 080.

. . . two advanced development models of a low-speed and a high-speed converter . . . digital-to-digital . . .

A STUDY OF SOME SELF-CORRECTING SEQUENTIAL NETWORKS
J. Rubio, Philips Res. Rep., vol. 17, no. 4, Aug. 1962, p. 315/329.

The problem of designing self-correcting counters is considered. Two different cases are studied. . . .

PULSE COUNTING AND FAST SCALING TRANSISTOR CIRCUITS
F. H. Wells, et al., J. Brit. Instn. Radio Engrs., vol. 23, no. 3, March 1962, p. 231/235.

The present state of fast transistor scaling circuits is reviewed and typical designs given . . .

DIODE MATRIX SHRINKS DECIMAL COUNTER
R. W. Wolfe, Electronics, vol. 35, March 1962, p. 50/52.

The circuit concept for a decimal counter which utilizes a compact package containing many diodes connected in a matrix is described.

HIGH-SPEED TRANSISTOR-TUNNEL-DIODE SEQUENTIAL CIRCUITS
J. J. Amodei, RCA Rev., vol. 24, no. 3, Sept. 1963, p. 355/380.

This paper describes some register, counter, and shift-register configurations for operation at high repetition rates. The results show that operation of any of these circuits at clock rates between 100 and 200 mc can be achieved reliably under realistic conditions and using commercially available components . . .

ANALYSIS AND SYNTHESIS OF TRANSITION-COUPLED ASYNCHRONOUS COUNTERS
W. Arnstein, et al., Case Inst. of Tech., Cleveland, Ohio, Digital Systems Lab., Oct. 1963, 173 p., refs., N64-11119.

A multibit counter, operating within the fundamental computer cycle, is a basic tool for computation. A parallel add 1-subtract 1 system is described which is logically designed for maximum speed. Checking logic is included to detect all single errors without increasing cycle time. . . .

MAGNETIC DECADE DEMONSTRATOR
M. J. Katz, Harry Diamond Labs., Washington, D.C., HDL TR1118, 20 May 1963, 17 p., AD 410 857.

TEST AND DISPLAY EQUIPMENT FOR MULTI-APERTURE SHIFT REGISTERS
P. Broomer, J. Brit. Instn. Radio Engrs., vol. 26, no. 4, Oct. 1963, p. 338/346.

The mode of operation of multi-aperture ferrite core devices is explained briefly and applications as shift registers discussed. An equipment for displaying the characteristics of the registers is described. . . .

DESIGN AND APPLICATION OF AN INCREMENTAL MAGNETIC COUNTER
E. A. Gurtler, Technical Services Lab., Picatinny Arsenal, Dover, N.J., PA TM1304 2, Jan. 1964, 16 p., AD 426 762.

. . . used a torroidal magnetic core which stores an increment of flux for each cycle of operation of the driving oscillator . . .

A NEW POLY-ANODE COUNTING TUBE, THE "POLYATRON"
Y. Hatta, et al., J. Brit. Instn. Radio Engrs., vol. 26, no. 5, Nov. 1963, p. 383/387.

A 4-MEGACYCLE 18-BIT CHECKED BINARY COUNTER
M. E. Homan, Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 516/522.

A magnetic core counter capable of counting from one to ten input events has been designed . . . provides an output pulse after a preselected number of events occur within the limit of the counter . . .

THEORY OF PULSE COUNTERS AND ITS APPLICATION
Z. Koutsky, Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 11 Jan. 1963, 26 p., incl. tables, 6 refs., Trans. no. FTD-TT-62-1495 from Aplikace Matematiky, 7:2, p. 116/140, 1962, AD 295 786.

. . . is nonsymmetrical, i.e., it can have various periods of relaxation in various positions and in different positions for transition into the next position. . .

THE SYNTHESIS OF NONLINEAR FEEDBACK SHIFT REGISTERS
K.B. Magleby, Stanford Electronics Labs., Stanford U., Calif., Rept. no. 63 118, TR 6207 1, Oct. 1963, 89 p., AD 428 081.

Two domains that describe the behavior of a feedback shift register were developed. These are the sequence and polynomial domains . . . related by an expansion of orthogonal functions. . . . To synthesize the shift register in the sequence domain, several properties of the output sequences are needed. . . . The cycles and output sequences of a simple, circulating shift register are used to synthesize an arbitrary feedback shift register.

CASCADED BINARY COUNTERS WITH FEEDBACK
M. P. Marcus, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 361/364.

A simple general method for analyzing any given cascaded binary counter feedback configuration is presented. The count can be determined directly from the diagram without the need of writing equations of any form.

PULSE COUNTING AND SCALING BY SHEFFER STROKE LOGIC
K.G. Nichols, Electronic Engineering, vol. 35, May 1963, p. 296/299, A63-24042.

ALL-MAGNETIC SHIFT REGISTER SCHEME STUDIES
E.K. Van De Riet, Stanford Research Inst., Menlo Park, Calif., Technical rept. no. 4, July 1963, 52 p., AD 419 410, AD 418 091.

THIN FILM LASER COUNTER
J. T. Winkler, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 793.

. . .a 13-substrate, 9-cubic inch, 30 mc counter utilizing hybrid thin film logic has been designed and demonstrated. . . .

DEVELOPMENT OF (PCM) DATA BUFFERS
M. Van Vlack, Stelma, Inc., Stamford, Conn., Quarterly progress rept. no. 2, 24 Oct. 1963-20 Jan. 1964, 20 Jan. 1964, 25 p., AD 435 083.

. . . for inserting a number of digital data channels into Data I or Data II of the PCM Multiplexers TD-352 ()/U or TD-353 ()/U . . .

COUNTING WITH NONLINEAR BINARY FEEDBACK SHIFT REGISTERS
M. Yoeli, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 357/361.

. . . methods of designing binary nonlinear feedback shift registers with cycles of specified length. First, the cycle structures of the simplest feedback functions, e.g., the circulating shift function, are considered. It is then shown how such structures may be modified, either by joining two suitable cycles into one or by the reverse process of splitting a cycle into two.

Related Publications:

A BIT ORIENTED SEQUENTIAL ACCESS MEMORY
C.H. Fischer, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 518/528.

. . . can be used to replace a multiplicity of serial shift registers at a considerable saving in components and power. . . .

Section 3A.26: Memory Units

3A.260: Digital and Analog Memories in General

Included: Books and surveys on storage techniques; Storage devices in general; Computer memories; Electronic memories; Solid state memories; Delay techniques.

Cross References: Mass storage devices (3A.360); Tape recording devices (3A.360); Organization of memories (3A.261).

Principal Publications:

A STATE-OF-THE-ART SURVEY OF DELAY TECHNIQUES
J. B. Brauer, et al., Rome Air Development Center, Griffiss Air Force Base, N. Y., RADC TR 60-146, Sept. 1960, AD 244 607.

. . . presently used techniques, future requirements of ground electronic systems and potential new mechanisms for achieving delay primarily in the frequency range above 1 mc. . . . Circulator and other techniques are discussed as well as periodic delay and amplification structures.

ELECTRONIC MEMORIES. A SURVEY (In Norwegian)
Y. Lundh, Elektrotek. Tidsskrift, vol. 74, no. 9, March 1961, p. 125/135.

PRINCIPLES OF DESIGNING MEMORY AND CODE SELECTION ELEMENTS FOR HIGH-FREQUENCY AUTOMATIC COMPUTER SYSTEMS
M. S. Neyman, Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 7, 1961, p. 1/8.

In earlier work. . . we considered general questions about designing automatic computer systems, in which radio-frequency waves with amplitude, phase and mixed recordings are used . . . This article discusses several methods which make it possible to effect memory elements for such systems and also for code selection devices. . . .

ELEKTRONISCHE AUSLESESPEICHER (Electronic Permanent Memories) (In German)
E. Schaefer, Elektronische Rechenanlagen, vol. 3, no. 5, May 1961, p. 197/205.

PRESS INTERVIEW WITH SOVIET MAKERS OF MEMORY DEVICES
V. Kurochkin, Joint Publications Research Service, Washington, D. C., JPRS 16666, 13 Dec. 1962, 10 p., AD 299 373.

THE DESIGN PROBLEMS OF A MEGABIT STORAGE MATRIX FOR USE IN A HIGH-SPEED COMPUTER
J. D. R. McQuillan, IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 390/404.

An examination of the properties of a pulse transmission matrix for a storage system is given in detail. . . .

COMPUTER MEMORIES—POSSIBLE FUTURE DEVELOPMENTS
J. A. Rajchman, RCA Rev., vol. 23, no. 2, June 1962, p. 137/151.

. . . Limits in attainable speed and storage capacity for magnetic memories of all types are estimated on basic, technological, and economic grounds. Cycle times of 100 nanoseconds for 4096 words are limiting for micro-magnetic ferrite and thin metal films. . . Tunnel-diode memories can obtain cycle times of 15 nanoseconds and superconductive memories may have storage capacities of billions of bits, thus extending beyond the limits of magnetic memories.

SOLID STATE MAGNETIC MEMORIES
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 88/90.

. . . study of spaceworthy solid-state magnetic memories.

MEMORY CONSIDERATIONS FOR AN ON-LINE PROCESSOR
E. F. Barrett, Proc. On-Line Data Proc. Appl. Conf., Jan./Feb. 1963, p. 9/213.

. . . comprehensive study of the storage needs for the modern on-line system. . . . check list for the on-line system designer.

. . . seems to consider only very large real-time systems. . . . author seems to have communication systems in mind in considering the various requirements.

Related Publications:

MAGNETICS FOR COMPUTERS—A SURVEY OF THE STATE OF THE ART
J. A. Rajchman, RCA Rev., vol. 20, no. 1, March 1959, p. 92/135, 44 refs.

The present-day applications of magnetics to random-access memories and logic switching are surveyed and appraised. The memory discussion includes core arrays, external addressing, apertured plates, thin films, and twistors. The survey of switching includes combinatorial switches, shift registers, current steering, voltage drives, transistor coupling, parametron, transfluxors, transfluxor current-steering, and multi-apertured transfluxors. . . .

DIGITAL APPLICATIONS OF MAGNETIC DEVICES
A. J. Meyerhoff(editor), New York, John Wiley and Sons, Inc., 1960, 604 p.

. . . is both a tutorial text and a reference handbook describing the theory, electrical design and logical design necessary for the development of digital systems using the magnetic core as the basic circuit element. . . .

SQUARE-LOOP FERRITE CIRCUITRY
C. J. Quartly, London, England, Iliffe Books Limited, 1962, 166 p.

. . . describes developments in Digital Computer storage systems employing square-loop ferrite core memories. . . .

SUMMARY OF INVESTIGATION ON ASSOCIATIVE MEMORIES
Computer Command & Control Co., Philadelphia, Pa., Rept. no. 5 101 5, 15 Jan. 1964, 11 p., AD 428 577.

3A.261: Organization of Memory Systems

Included: Associative memories; Multi-list type associative memories; Computer simulation of memory systems; One-level storage system; Fixed word-length memories; Content-addressable memory systems (CAM); Serial matrix storage systems; Theory of storage systems; Bit-oriented sequential access memory.

Cross References: Machine organization of data processors (3A.130); Simulation methods (Div. 3A.6).

Principal Publications:

PHYSICAL VERSUS LOGICAL COUPLING IN MEMORY SYSTEMS
J. A. Swanson, IBM J. Res. Developm., vol. 4, July 1960, p. 305/310.

. . . demonstrated that less material is required to store information if, in addition to physical coupling on the atomic scale, logical coupling, i.e., coding and redundancy, can be utilized. Thus the quantity of material associated with a fixed amount of information can be reduced even though a larger total number of bits must be used to achieve a fixed level of reliability. . . . does not consider specific techniques to realize logical coupling. . . .

A MAGNETIC ASSOCIATIVE MEMORY
J. R. Kiseda, et al., IBM J. Res. Developm., vol. 5, April 1961, p. 106/121.

. . . a parallel-search-on-content memory using even conventional noncryogenic components has clearly been established. . . by the paper under review. . . . the authors propose a system organization in which content addressing and both destructive and nondestructive location addressing are ingeniously integrated. This is accomplished by arranging the outputs of the word-match detectors in a rectangular array, corresponding to the rectangular selection switch used for location addressing.

SERIAL MATRIX STORAGE SYSTEMS
M. Lehman, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 247/252.

Coincident-current techniques, usually associated with parallel ferrite-core stores, may also be used for the operation of serio-parallel or purely serial memories. After outlining, in block diagram form, one possible physical realization of a serial system, the paper examines the conditions under which such a store is economically justified.

ONE-LEVEL STORAGE SYSTEM
T. Kilburn, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 223/235.

After a brief survey of the basic Atlas machine, the paper describes an automatic system which in principle can be applied to any combination of two storage systems so that the combination can be regarded by the machine user as a single level. The actual system described relates to a fast core store-drum combination. The scheme incorporates a "learning" program, a technique which can be of greater importance in future computers.

AN ORGANIZATION OF AN ASSOCIATIVE CRYOGENIC COMPUTER
R. F. Rosin, Proc. AFIPS Spring Joint Computer Conf., May 1962, p. 203/212.

Considerable interest has been recently focused on so-called "associative" or "data addressed" memories, in which a word of data is retrieved on the basis of part or all of its contents. Such memories are to be contrasted with conventional random access memories in which a word is addressed by means of its storage location.

ASSOCIATIVE MEMORY WITH ORDERED RETRIEVAL
R. R. Seeber, et al., IBM J. Res. and Developm., vol. 6, Jan. 1962, p. 126/136.

. . . utilizing cryogenic circuitry. . . its functions are compared with those of previously published associative memory descriptions. The ordered-retrieval sorting algorithm is described, along with its implementation by means of a ternary interrogating counter.

VARIABLE FIELD-LENGTH DATA MANIPULATION IN A FIXED WORD-LENGTH MEMORY
M. J. Flynn, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 512/516.

. . . The purpose of this report is to describe several representative memory-access systems that avoid the housekeeping necessary for processing variable-length operands in a fixed word-length machine and to evaluate their relative efficiencies.

CONTENT-ADDRESSABLE MEMORY SYSTEMS
R. H. Fuller, California U., Los Angeles, Rept. no. 63 25, June 1963, 549 p., AD 417 644.

. . . Word cells within CAM may be addressed by the character of all or a part of cell contents. Multinumbered sets of word cells may be addressed simultaneously. . . . allow simultaneous transformation of multinumbered sets. . . allow communication between neighboring word cells. A novel set of logical and arithmetic commands is proposed for the extended CAM and algorithms are given for execution of these commands. . . .

A CONTENT ADDRESSABLE DISTRIBUTED LOGIC MEMORY WITH APPLICATIONS TO INFORMATION RETRIEVAL
C. Y. Lee, et al., Proc. IEEE, vol. 51, no. 6, June 1963, p. 924/932.

A MEMORY ORGANIZATION FOR AN ELEMENTARY LIST-PROCESSING COMPUTER
V. O. Muth, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 262/265.

This paper presents an elementary computer memory organization capable of direct representation and manipulation of simple linear lists. A conventional random-access memory is used in conjunction with a group of address and word-length registers to store and manipulate single-link list words. Four typical list-processing macroinstructions, INSERT, DELETE, SEARCH, and EXECUTE, are illustrated and a sequence of microsteps for accomplishing each is given.

THE ORGANIZATION OF A MULTILIST-TYPE ASSOCIATIVE MEMORY
N. S. Prywes, et al., IEEE Trans. Commun. Electronics, no. 68, Sept. 1963, p. 488/492.

. . . The use of an addressable memory for an associative memory provides a flexibility which is more difficult to achieve with a memory having associative features built into the hardware. One way to do this is to organize the information in the multilist structure which is the subject of this paper.

ASSOCIATIVE MEMORY ALGORITHMS AND THEIR CRYOGENIC IMPLEMENTATION
J. L. Rogers, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Rept. no. 8670 6007RU000, Dec. 1963, 113 p., AD 429 521.

. . . design of a versatile cryogenic associative memory. . . analytical survey of existing algorithms for associative memories . . .

A MATHEMATICAL MODEL FOR AN ASSOCIATIVE MEMORY
G. J. Simmons, Sandia Corp., Albuquerque, N. Mex., Monograph, April 1963, 100 p., 23 refs., N63-19185.

. . . uses associative addressing and distributed storage. Associative addressing is accomplished by mapping from a space with relatively few dimensions (input variables) to the vertices of a binary-valued hypercube embedded in a much higher dimensional space.

COMPUTER SIMULATION OF THE ELECTRICAL PROPERTIES OF MEMORY ARRAYS
W. T. Weeks, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 874/887.

The evolution of a simple mathematical model for pulse propagation in memory arrays and its implementation by computer programs is described.

Related Publications:

THE THEORY OF STORAGE
P. A. Moran, Methuen's Monographs on Applied Probability and Statistics, distributed in USA by John Wiley and Sons, Inc., New York, N.Y., 1959, 111 p.

. . . survey of certain of the basic probabilistic problems which arise in the theory of storage. These problems are of two types. The first type. . . pertains to the Inventory Storage. . . the second type. . . concerns Dam Storage. . .

A BIT ORIENTED SEQUENTIAL ACCESS MEMORY
C. H. Fischer, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 518/528.

. . . can be used to replace a multiplicity of serial shift registers at a considerable saving in components and power. This paper discusses the organization of such a memory and shows how it can be used to function as a single word or a multiple word register and to provide for the operations of "right" shift of one bit.

3A.262: Memory Support Circuits

Included: Magnetic load sharing switches; Decode switches; Scanners; Elastic switches; Sense amplifiers; Matrix switches; Impulse switching techniques for memories.

Not Included: Deflection circuits for electron beam storage devices; Power supply circuits.

Cross References: Logical circuits (Sect. 3A.22); Analog amplifiers (3A.233).

Principal Publications:

SCANNERS FOR FERROELECTRIC MEMORY CAPACITORS
G. F. Pulvar, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 34/40.

. . . Scanning systems by which binary information can be stored and recalled from ferroelectric capacitor configurations. . . Adaptable to random access application.

MAGNETIC CORE PULSE-SWITCHING CIRCUITS FOR STANDARD PACKAGES
J. L. Rosenfeld, IRE Trans. Electronic Comp., vol. EC-7, no. 3, Sept. 1958, p. 223/228.

A new method for the logical design of magnetic core pulse-switching circuits is presented. . . . absence of spurious noise signals at the output. . . outputs are independent of the order of arrival of input pulses. . . interchanging components does not affect circuit behavior. . . moderate changes in clock pulse amplitude and duration do not cause false operation.

MATRIX SWITCH AND DRIVE SYSTEM FOR A LOW-COST MAGNETIC-CORE MEMORY
W. A. Christopherson, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 238/246.

A unique system of ferrite-core matrix switches and drivers has been developed for a low-cost magnetic-core memory. The memory uses coincident-current techniques and has a capacity of 10,000 characters with seven bits per character. . . .

TUNNEL DIODE CIRCUITS FOR SWITCHING THIN FILM MEMORIES
P. C. Davis, Electronic Systems Lab., MIT, Cambridge, Mass., Technical memo. TM-100, Jan. 1961, 81 p., AD 257 015.

. . . are investigated theoretically as a source of high-speed current pulses capable of switching thin film memories in the order of tens of millimicroseconds. Breakpoint models of the characteristic curve are constructed and piece wise linear analysis is used to predict and extrapolate experimental results. Three basic circuits were chosen as drivers for various load forms and levels. These were tried in the laboratory and results are given.

AC AND IMPULSE SWITCHING TECHNIQUES FOR USE WITH MAGNETIC MEMORIES
R. E. McMahon, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 312G-0006, 26 June 1961, 22 p., AD 259 503.

The application of a HF ac drive current to cores that have been partially switched by an impulse current was used in extending the previously developed model of switching.

DESIGN OF MEMORY SENSE AMPLIFIERS
G. H. Goldstick, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 236/253.

A fundamental problem in the design of fast . . . word oriented memories using S-1 core material is the realization of a sensing amplifier which has the multitude of required properties. This newly developed sense amplifier and its operation and design are presented.

IMPROVING THE PERFORMANCE OF THE SENSE-AMPLIFIER CIRCUIT THROUGH PRE-AMPLIFICATION STROBING AND NOISE-MATCHED CLIPPING
F. F. Tsui, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 677/683.

For the improvement of the performance of the sense-amplifier circuit for conventional ferrite-core memories, the principles of pre-amplification strobing and noise-matched clipping are proposed and discussed.

STUDY OF ELASTIC SWITCHING FOR ASSOCIATIVE MEMORY SYSTEMS (Final Report)
R. T. Hunt, et al., Goodyear Aerospace Corp., Akron, Ohio and Griffiss AFB, N. Y., Inform. Processing Branch, RADC-TDR-63-483, Feb. 1964, 50 p., N64-17151, AD 432 041.

A TOROIDAL NONDESTRUCTIVE READ MEMORY ELEMENT USING BIAS RESTORATION
M. Teig, et al., Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 523/527.

The operation of a 1-core-per-bit magnetic nondestructive read (NDR) element using a bias restoration technique is discussed. Non-destructive read time of 100 nsec (nanoseconds) was easily achieved. . . .

TUNNEL-DIODE THRESHOLD DISCRIMINATOR TOLERANCE ANALYSIS—APPENDIX II TO "A HIGH-SPEED DIRECT-COUPLED MAGNETIC MEMORY SENSE AMPLIFIER EMPLOYING TUNNEL-DIODE DISCRIMINATORS"
E. T. Ulzurrun, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 296/299.

STUDY OF ELASTIC SWITCHING FOR ASSOCIATIVE MEMORY SYSTEMS
R. T. Hunt, et al., Goodyear Aircraft Corp., Akron, Ohio. Final rept., RADC TDR 63 483, Feb. 1964, 50 p., AD 432 041.

Various ferrite materials were tested for elastic switching properties that will increase the speed of associative memory systems.

. . . utilizes high-amplitude, narrow-width (50 nsec) read-pulses that permit nondestructive readout. . . .

A HIGH-SPEED DIRECT-COUPLED MAGNETIC MEMORY SENSE AMPLIFIER EMPLOYING TUNNEL-DIODE DISCRIMINATORS
B. A. Kaufman, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 282/295.

DECADE SWITCH FOR SETTING MAGNETIC CORES
G. W. Kinzelman, Harry Diamond Labs., Washington, D. C., 20 May 1963, 18 p., AD 406 854.

. . . special single-wafer decade switch intended to replace a conventional six-wafer 10-position switch.

MAGNETIC LOAD-SHARING SWITCHES FOR HIGH-SPEED APPLICATIONS
R. B. Lochinger, RCA Rev., vol. 24, no. 2, June 1963, p. 166/181.

The COST of a modern high-speed computer memory is greatly influenced by the cost of its electronic drive circuits. . . due to the memory organization, only a very small percentage of the drivers are excited and delivering current at any one time. Thus, a great deal of expensive equipment is idle most of the time. Matters are improved considerably if a number of drivers are used to deliver current simultaneously to a selected load. This is accomplished by means of magnetic load-sharing switches.

3A.263: Electron Beam Storage Devices

Included: Scan-conversion storage tubes; Mirrechon signal storage tube; Photo-electric information storage; Storage tubes; Flying spot store; Dielectric storage tape inside tubes; Meshless storage tube; Iatron storage tube; Barrier grid storage tube; Permachon storage tube; Electrostatic signal recording; Memory tubes; Travelling image storage tube; Two-color direct view storage tube.

Not Included: Accessory circuits for electron beam tubes; Electron tube design and manufacture; Camera tubes; Picutre tubes; Electron gun design; Vacuum techniques.

Cross References: Display tubes (3A.380).

Principal Publications:

A HIGH-SPEED BARRIER GRID STORE
T. S. Greenwood, et al., Bell Syst. Tech. J., vol. 37, no. 5, Sept. 1958, p. 1195/1220.

. . . high-speed random access memory developed to serve an experimental electronic telephone switching system. . . . incorporated in a complete general-purpose store with a capacity of 16,384 bits. Random access to any bit together with a full storage cycle of reading and writing is complete in 2.5 microseconds, permitting a 400-kc repetition rate.

FUNDAMENTAL CONCEPTS IN THE DESIGN OF THE FLYING SPOT STORE
C. W. Hoover, Jr., et al., Bell Syst. Tech. J., vol. 37, no. 5, Sept. 1958, p. 1161/1194.

. . . a semipermanent information storage system developed for use in an electronic switching system which utilizes cathode ray tube access to information stored on photographic emulsion.

BEAM-POSITIONING SERVO SYSTEM FOR THE FLYING SPOT STORE
L. E. Gallaher, Bell Syst. Tech. J., vol. 38, no. 2, March 1959, p. 425/444.

THE DESIGN OF A LARGE ELECTROSTATIC MEMORY
M. Graham, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 4, Sept. 1959, p. 479/485.

A large, high-speed random-access memory for the Brookhaven "Merlin" digital computer is described. This system employs barrier grid electrostatic storage tubes in a novel configuration yielding improved reliability.

SYSTEM DESIGN FOR THE FLYING SPOT STORE
C. W. Hoover, Jr., Bell Syst. Tech. J., vol. 38, no. 2, March 1959, p. 365/424.

II. STORAGE TUBES (In German)
J. E. Otto, et al., Telefunken Zeitung, vol. 32, no. 125, Sept. 1959, p. 209.

IMPROVED BARRIER-GRID STORAGE TUBE, VOLUME I
J. M. Abraham, et al., ITT Federal Labs., Fort Wayne, Ind., Final Rept. no. 4 - 1 April 1960-11 Aug. 1961, 20 Sept. 1961, 72 p., AD 271 555.

. . . was designed incorporating a secondary emission collector-amplifier. . . . developed from rubber membrane studies. . . Tube fabrication procedures, test equipment and cabling diagrams were prepared.

PRODUCTION ENGINEERING MEASURE FOR TYPE FW-202 BARRIER GRID STORAGE TUBE
J. M. Abraham, ITT Industrial Labs., Fort Wayne, Ind. Quarterly progress rept. no. 4, 1 April-30 June 1962, 23 July 1962, 16 p., incl. illus., AD 283 096.

RESEARCH AND DEVELOPMENT TO IMPROVE THE RESOLUTION OF IATRON DIRECT VIEW STORAGE TUBES
R. H. Clayton, ITT Industrial Labs., Fort Wayne, Ind. Interim development rept., 22 Feb.-22 May 1962, 12 June 1962, 42 p., incl. illus., tables, refs., AD 276 897.

RESEARCH AND DEVELOPMENT TO IMPROVE THE RESOLUTION OF IATRON DIRECT VIEW STORAGE TUBES
R. H. Clayton, et al., ITT Industrial Labs., Fort Wayne, Ind. Interim development rept. 23 March-22 Aug. 1962, 4 Oct. 1962, 16 p., incl. illus., AD 285 256.

A magnetically focused and deflected Iatron tube was built. . . .

SCAN-CONVERSION STORAGE TUBE BASED UPON THE PERMACHON
R. J. Doyle, Westinghouse Electric Corp., Elmira, N. Y., Final rept., 1 July 1960-31 Dec. 1962, 64 p., AD 400 719.

See also AD 276 493, and AD 291 829.

RECENT ELECTRON OPTICAL DEVELOPMENTS IN THE RECORDING FIELD
P. H. Gleichauf, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 366/370.

A brief review of the gun requirements for different electron beam recording techniques and of the imposed limitations, is followed by descriptions of several electron optical design approaches. Storage and printing tubes are not discussed, although some of the techniques are also applicable to these tubes. Discussed in more detail are the techniques for obtaining the required gun demagnifications, such as the use of relay lens systems, crossed cylindrical lenses, pre-focus deflection. . . .

FEASIBILITY OF A MESHLESS STORAGE TUBE
N. L. Lehrer, Hughes Research Labs., Malibu, Calif. Interim scientific rept. no. 2., 15 May-14 Sept. 1962, 14 Sept. 1962, 27 p., incl. illus., tables, 2 refs., AD 285 380.

See also AD 276 493, AD 284 824 and AD 291 892.

REFLECTED ION BEAM RECORDING ON DIELECTRIC FILMS
J. Litton, Martin Marietta Corp., Baltimore, Md., RADC TDR 62-172, March 1962, 31 p., incl. illus., 22 refs., AD 278 113.

. . . results of literature surveys of particle deposition methods and positive ion generation techniques. . . description of the electron and ion guns used for recording, . . .

PHOTOELECTRIC INFORMATION STORAGE
W. G. Reininger, et al., Westinghouse Electric Corp., Baltimore, Md., Interim engineering rept. no. 1, 1 June-31 Aug. 1962, 31 Aug. 1962, 14 p., incl. illus., AD 291 551.

. . . design parameters of a tape camera storage tube. This device will be able to take pictures in visible light by means of a photoemissive surface, store many of these pictures as an electric charge pattern on a dielectric on a metal base tape, on command read this information out as a video signal at a very high data rate, on command erase the unwanted information and reuse the storage tape a great many times. . . .

ELECTRICAL READOUT FOR WIDEBAND ELECTRON BEAM RECORDING
K. F. Wallace, et al., Ampex Corp., Redwood City, Calif. Final rept., RADC TDR 62-394, 27 Sept. 1962, lv. incl. illus., table, AD 293 201.

RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE
P. P. Damon, Vacuum Tube Products Div., Hughes Aircraft Co., Oceanside, Calif. Interim development rept., 1 Oct. 1963-1 Jan. 1964, Jan. 1964, 18 p., AD 432 055.

. . . capable of displaying stored information in either of two colors or in intermediate hues, and selectively erasing that information . . . See also AD 428 609.

SCAN-CONVERSION STORAGE TUBE BASED UPON THE PERMACHON
R. J. Doyle, Westinghouse Electric Corp., Elmira, N. Y., Quarterly progress rept. no. 4, 1 Oct.-31 Dec. 1963, 31 Dec. 1963, 25 p., Rept. no. 14, AD 435 784.

See also AD 427 270.

A SCAN-CONVERSION TUBE UTILIZING FIBER-OPTICS PHOTON TRANSFER
R. J. Doyle, IEEE Trans. Electron Devices, vol. ED-10, Nov. 1963, p. 410/416.

. . . consists basically of a reading electron gun, a writing electron gun and an interjacent scan-conversion target. . . .

BEITRAG ZUR SIGNALERZEUGUNG BEI SPEICHERROHREN (Contribution to the Signal Generation in Storage Tubes) (In German)
W. Harth, Arch. Elekt. Uebertragung, vol. 17, Feb. 1963, p. 64/68.

. . . For storage tubes with fast scanning electrons (secondary electron yield > unity) the scanning mechanism and the signal generation are stated in general terms. For three important potential distributions written on the storage layer the influence of the secondary-emission re-charging and the bell-shaped current distribution of the scanning beam on the shape of the output signal is investigated. . . .

DEVELOPMENT OF THE MIRRECHON SIGNAL STORAGE TUBE
A. S. Jensen, et al., Westinghouse Electric Corp., Baltimore, Md., Quarterly rept. no. 3, Nov. 1962-Jan. 1964, Jan. 1964, 14 p., AD 432 225.

. . . will be capable of electric charge pattern storage, nondestructive reading, gray scale, simultaneous reading, writing and erasing without excessive crosstalk, electrostatic focus and deflection and electron multiplier output. . . .
See also AD 424 896, AD 418 341.

DIELECTRIC STORAGE TAPE FOR A STORAGE CAMERA TUBE
A. S. Jensen, et al., Proc. Nat. Winter Conv. Mil. Electronics, vol. 2, May 1963, p. 26/35.

DISCUSSION AND APPLICATIONS OF ELECTROSTATIC SIGNAL RECORDING
I. M. Krittman, et al., RCA Rev., vol. 24, no. 3, Sept. 1963, p. 406/420.

. . . incorporating principles and techniques underlying the photodielectric tape camera is described. General expressions for the recorder signal-to-noise ratio and packing density are derived. Experimental results of a study of high-resolution camera tubes are used to predict typical recorder characteristics. . .

ENHANCED BOMBARDMENT INDUCED CONDUCTIVITY STORAGE TARGET FOR MEMORY TUBES
N. H. Lehrer, Hughes Research Labs., Malibu, Calif., Interim engineering rept. no. 1, 4 Dec. 1963-31 March 1964, 31 March 1964, 29 p., AD 435 968.

. . . SEBIC film. . . It was found that with optical input it was possible to store information for many minutes with resolution of thousands of lines per inch. . . .

DINAMIKA DVIZHENIIA VSTRECHNYKH PUCHKOV S UCHETOM IKH VZAIMODEISTVIIA V NAKOPITEL'NYKH SISTEMAKH (Dynamics of Motion of Opposite Beams with Regard to Their Interaction in Storage Systems) (In Russian)
E. M. Moroz, Zhurnal Tekhnicheskoi Fiziki, vol. 33, April 1963, p. 455/461, A63-16955.

RESEARCH IN ADVANCED PHOTOELECTRIC INFORMATION STORAGE
W. G. Reininger, et al., Westinghouse Electric Corp., Baltimore, Md. Final rept., June 1962-July 1963, Rept. no. 437D, RTD TDR63 4134, Nov. 1963, lv., AD 423 982, N64-12188.

DATA STORAGE FOR METEOROLOGICAL SATELLITES
M. I. Schneebaum, et al., Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 48/51, A63-15190.

Discussion of the advanced research being conducted by the Goddard Space Flight Center in the field of electronic and magnetic data storage of video information in meteorological satellites. The storage vidicon, which is the heart of the Automatic Picture Transmission System (APTS) to be used on Nimbus, and the dielectric tape camera, also being developed for Nimbus, are detailed and analyzed. The conventional vidicons with magnetic tape as the storage medium, now in use on Tiros satellites, are also reviewed.

Related Publications:

ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS, VOL. 16: PHOTO-ELECTRONIC IMAGE DEVICES
J. D. McGee, et al. (editors), New York and London, Academic Press, Inc., 1962, 639 p.

. . . is the second of the series to be devoted to the subject of photoelectronic imaging devices. Like its predecessor, Volume XII, it consists of the proceedings of a symposium held in London at the Imperial College of Science and Technology. . . . sixty-five papers. . .

AN X-RAY TELEVISION SYSTEM WITH IMAGE STORAGE AND AUTOMATIC EXPOSURE-RELEASE
A. J. Seyler, J. Brit. Instn. Radio Engrs., vol. 24, no. 3, Sept. 1962, p. 229/240.

DEVELOPMENT OF A DISPLAY STORAGE TUBE TO BE USED AT HIGH TEMPERATURES
R. P. Stone, Radio Corp. of America, Lancaster, Pa. Final engineering rept., July 1959-July 1961, 14 May 1962, 28 p., AD 288 478.

AUTOMATIC RADAR DATA EXTRACTION BY STORAGE TUBE AND DELAY LINE TECHNIQUES
J. C. Plowman, J. Brit. Instn. Radio Engrs., vol. 26, no. 4, Oct. 1963, p. 317/328.

. . . One system involves the use of storage tubes and the other employs fused quartz delay lines as the necessary storage medium. . . .

ON THE USE OF THE VIDICON CAMERA TUBE AS A VIDEO STORAGE DEVICE
J. B. Potter, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 12, Dec. 1963, p. 855/865.

. . . In this paper, a discussion of the factors which are of main importance when the vidicon is used as a store (as opposed to normal camera usage) is undertaken with particular reference to the circuit requirements dictated by these factors. Practical circuits of interest in meeting these requirements are also described. . . .

RESEARCH AND DEVELOPMENT ON TRAVELING IMAGE STORAGE TUBE
G. R. Spencer, Raytheon Co., Newton, Mass. Interim engineering rept. no. 2, 16 Feb.-31 March 1964, April 1964, 15 p., AD 436 037.

. . . display device to be used in aircraft and space vehicles, which will provide a continuously-moving, two-dimensional image, generated from information obtained from a line-scan sensor in combination with the forward motion of the vehicle. . . .
See also AD 433 860.

APPLIED RESEARCH ON PHOTOCONDUCTIVE PHOTO-TAPE
RCA Labs., Div., Radio Corp. of America, Princeton, N. J. Final rept., Rept. no. R2087, 20 March 1964, 192 p., AD 434 360.

3A.264: Core Memories

Included: Ring core magnetic memory; Coincident-current core memories; Sequential magnetic-core storage systems; Ferrite memories; Diode-steered magnetic-core memory; Non-destructive readout core memory; Micro-aperture ferrite memory; Laminated ferrite memory; Magnetic associative memory; Fluxlok memory technique.

Not Included: Magnetic core developments; Magnetic materials.

Cross References: Memory organization (3A.261).

Principal Publications:

A TRANSISTOR-DRIVEN MAGNETIC-CORE MEMORY USING NON-COINCIDENT CURRENT TECHNIQUES
R. L. Koppel, Proc. Nat. Symp. Telem., no. 1.3, Sept. 1958, p. 1/10.

DIODE-STEERED MAGNETIC-CORE MEMORY
A. Melmed, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 4, Sept. 1959, p. 474/478.

. . . techniques which take advantage of word arrangement to make possible large, high-speed magnetic-core memories at moderate cost. Economy is obtained by means of a two-coordinate selection system using diffused junction rectifiers as steering diodes. . . . The familiar "inhibit" line is eliminated, reducing the memory array to a two-wire configuration.

FERRITE-CORE MEMORY SYSTEMS WITH RAPID CYCLE TIMES
D. B. G. Edwards, et al., Proc. Instn. Elect. Engrs. Pt. B, vol. 107, no. 36, Nov. 1960, p. 585/598.

A DIGITAL COMPUTER STORE WITH VERY SHORT READ TIME
T. Kilburn, et al., Proc. Instn. Elect. Engrs. Pt. B, vol. 107, no. 36, Nov. 1960, p. 567/572.

. . . One form of the store which has been constructed has a capacity of 200000 bits of permanent information and another has been built with a capacity of 100000 bits, the whole contents of which may be changed in under one minute. The technique employed permits the construction of very large stores at low cost. Each digit cell is formed, basically, by two sets of windings which form the primary and secondary of a transformer and the two binary states are determined by the presence or absence of a piece of linear ferrite material coupling the windings. . . . a time of 100 millimicrosec is typical. . . .

A WORD-ORIENTED TRANSISTOR DRIVEN NON-DESTRUCTIVE READOUT MEMORY
T. C. Penn, et al., Proc. Western Joint Comp. Conf., May 1960, p. 83/90.

. . . using a novel magnetic matrix switch with a three-aperture ferrite memory cell.

SUBMICROSECOND CORE MEMORIES USING MULTIPLE COINCIDENCE
H. P. Schlaeppi , et al., IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 192/198.

Memories using toroidal ferrite cores with cycle times less than a microsecond are described; the selection ratio is increased by the use of biasing and the multiple coincidence principles of Minnick and Ashenhurst. . . . The "two-core switch" is then briefly described. . . .

FLUXLOK - A NONDESTRUCTIVE, RANDOM-ACCESS ELECTRICALLY ALTERABLE, HIGH-SPEED MEMORY TECHNIQUE USING STANDARD FERRITE MEMORY CORES
R. M. Tillman, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 323/328.

. . . uses the principle of cross-field magnetization to achieve the nondestructive sensing . . .

A MAGNETIC ASSOCIATIVE MEMORY
J. R. Kiseda, et al., IBM J. Res. Developm., vol. 5, no. 2, April 1961, p. 106/122.

Describes a computer storage system in which data flows in and out of the memory on the basis of content rather than location (address). In addition, a small experimental model of this system is described, using ferrite cores as novel associative memory storage elements.

A MAGNETIC ASSOCIATIVE MEMORY SYSTEM
W. L. McDermid, et al., IBM J. Res. Developm., vol. 5, no. 1, Jan. 1961, p. 59/62.

. . . composed of ferrite cores with nondestructive readout and a special system of retrieving the information. This consists of interrogating the whole memory for a word whose most significant part matches the required pattern. The memory can be interrogated for a word matching several required patterns and this is done simultaneously . . . The answer gives the word and its address . . . Retrieving the information takes 6 microseconds. . . .

A 0.7 MICROSECOND FERRITE CORE MEMORY
W. H. Rhodes, et al., IBM J Res. Developm., vol. 5, July 1961, p. 74/82.

. . . describes the design and development of a high speed ferrite core memory. The word-organized memory makes use of partial switching methods using two cores per bit to achieve a short memory cycle of 0.7μsec.

HIGH-SPEED FERRITE MEMORIES
H. Amemiya, et al., Proc. AFIPS Fall Joint Computer Conf., Dec. 1962, p. 184/197.

. . . discussion is essentially confined to the magnetic design of word-organized two-core-per-bit systems in which the digit current assists the action of the write current in the word wire, and in this respect there is little which is new.

THE MEASUREMENT AND REDUCTION OF NOISE IN COINCIDENT-CURRENT CORE MEMORIES
P. Cooke, et al., Proc. Instn. Elect. Engrs., Pt. B, vol. 109, no. 47, Sept. 1962, p. 383/389.

. . . The paper is based on an experimental investigation into the noise voltages which can appear on the sense wire of a coincident-current memory plane using ferrite cores. . . .

A RING CORE MAGNETIC MEMORY FOR 128 CHANNELS (In German)
W. Helmberger, Nukleonik, vol. 4, no. 7, Oct. 1962, p. 288/299.

MICROAPERTURE HIGH-SPEED FERRITE MEMORY
R. Shahbender, et al., Proc. Fall Joint Comp. Conf., Dec. 1962, p. 197/212.

The advantages of miniaturizing memory elements are well known. This paper describes the use of electron beam drilling to obtain ferrite elements that have magnetic paths whose lengths are the shortest reported to date. The resultant geometries (even though multiapertured) approximate toroids and are operated in conventional modes.

MICROAPERTURE HIGH-SPEED FERRITE MEMORY
R. Shahbender, et al., RCA Rev., vol. 23, no. 4, Dec. 1962, p. 539/566.

A SEQUENTIAL MAGNETIC-CORE STORAGE SYSTEM (Correspondence)
A. J. Lincoln, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 917/918.

In certain computers the storage is addressed according to a fixed sequence. When this occurs, simplifications of the memory-access circuitry may be obtained. . . . description of a ferrite storage system developed for use in a real-time digital differential analyzer (DDA), although the principles involved apply to other types of computers as well.

LAMINATED FERRITE MEMORY
R. Shahbender, et al., RCA Rev., vol. 24, no. 4, Dec. 1963, p. 705/729.

Related Publications:

A NEW CORE SWITCH FOR MAGNETIC MATRIX STORES AND OTHER PURPOSES
I. P. V. Carter, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 176/191.

. . . analyzes the conventional uses of magnetic switch cores to drive matrix stores in both current-driven and voltage-driven modes. A new method of using switch cores is proposed and analyzed which offers, at the cost of replacing in every selection line the usual switch-core and terminating resistor by two smaller cores . . .

LOGIC CIRCUITS USING SQUARE-LOOP MAGNETIC DEVICES: A SURVEY
J. L. Haynes, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 191/203.

. . . a capsule view of twenty-four square-loop magnetic logic circuits which have been proposed or developed so far, with a brief description of the way each circuit or circuit family meets the requirements of logic circuitry. . . . consistent terminology . . .

SUBMINIATURE COMPUTER DESIGNED FOR SPACE ENVIRONMENTS
W. A. England, Rec. Nat. Symp. Space Electronics Telemetry, no. 7.1, Oct. 1962,

. . . use of a solid state nondestructive readout ferrite memory . . .

MAGNETIC CORE ACCESS SWITCHES
R. C. Minnick, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 352/368.

A number of the more commonly known magnetic core access switches are combined in a single analytical model. . . . produces many apparently new switches. . . . The current knowledge is reviewed on a fairly recent and important class of access switches, known as load-sharing zero-noise switches.

ON THE LOGICAL DESIGN OF NOISELESS LOAD-SHARING MATRIX SWITCHES
P. G. Neumann, IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 369/374.

A noiseless matrix switch is a selection switch in which, for a given set of inputs, one corresponding output (the selected output) is nonzero while all other outputs are zero; the switch is load-sharing with efficiency one if all nonzero inputs contribute to the selected output with the same sign.

This paper develops a general theory of noiseless load-sharing matrix switches, from which many new switches can be derived.

LOAD-SHARING CORE SWITCHES BASED ON BLOCK DESIGNS
R. C. Singleton, IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 346/352.

Designs for load-sharing zero-noise core switches have been proposed by Constantine, Marcus, and Chien. Blachman has proposed a core memory wiring plan which with modification can be converted to a load-sharing zero-noise switch. An examination of these switch plans shows that they have a common relationship to a class of mathematical structures known to mathematicians and statisticians as balanced incomplete block designs. This relationship is formulated, and it is then shown that all balanced incomplete block designs lead to load-sharing zero-noise switches.

3A.265: Analog Memory Units

Included: Delay lines; Magnetostrictive ultrasonic delay lines; Buffer storage devices; Recirculating memories; Multiple synchronous storage of pulsed signals; Dispersive ultra-sonic delay lines; Interdigital delay lines; Semi-conductor delay lines; Variable artificial delay lines.

Not Included: Ultra-sonic physics; Magnetostrictive transducers; Circuit theory of delay lines.

Cross References: Ultra-sonic technologies for data processing (3A.215).

Principal Publications:

DESIGN OF A DELAY LINE FOR AN ANALOG CORRELATOR
T. R. Benedict, et al., Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 715/723.

An m-derived delay line intended for use in a high speed analog correlator is described whose design and adjustment have led to the following specifications: Band: 0 to 3000 cps. Attenuation: Total average loss of about 15 db . . . Delay . . . adjustable in 40 steps to approximatley 2 milliseconds . . .

A NOTE ON THE DISPERSION OF INTERDIGITAL DELAY LINES
F. Paschke, RCA Rev., vol. 19, no. 3, Sept. 1958, p. 418/422.

It is shown that the effect of the blackwall on the dispersion of an interdigital delay line can be taken into account by a lumped susceptance which periodically loads the "ideal" line. Experimental results are in good agreement with the theory. . . .

MAGNETOSTRICTIVE ULTRASONIC DELAY LINES FOR A PCM COMMUNICATION SYSTEM
D. A. Aaronson, et al., IRE Trans. Joint Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 329/332.

A servo-operated delay-line pad and a temperatures-compensated delay-line memory, both magnetostrictively driven at 1.5 mc, have been used in an experimental PCM communication system. . . .

A STATE-OF-THE-ART SURVEY OF DELAY TECHNIQUES
J. B. Brauer, et al., Rome Air Development Center, Griffiss Air Force Base, N. Y., RADC TR 60-146, Sept. 1960, AD 244 607.

. . . presently used techniques, future requirements of ground electronic systems and potential new mechanisms for achieving delay primarily in the frequency range above 1 mc. Carrier frequency techniques employing propagation of both electromagnetic and acoustic waves in solid and gaseous media are reviewed. Circulator and other techniques are discussed as well as periodic delay and amplification structures.

PHOTOELASTIC ULTRASONIC DELAY LINES
H. A. Brouneus, et al., Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, 835/839.

. . . high-efficiency transducers have now been made. . . . capability of providing addition or multiplication of two or more signals by proper arrangement of optical elements. . . . have been operated at frequencies up to 30 megacycles with delays up to 160 microseconds. . . .

A COMPARISON OF SEVERAL DISPERSIVE ULTRASONIC DELAY LINES USING LONGITUDINAL AND SHEAR WAVES IN STRIPS AND CYLINDERS
A. H. Fitch, IRE Conv. Rec. Pt. 6, vol. 8, March 1960, p. 284/292.

ANALOG TIME DELAY SYSTEM
C. D. Hofmann, et al., Western Joint Comp. Conf., May 1960, p. 103/108.

This device is a special magnetic-tape system which can reproduce signals with an error of less than 0.1 per cent for all frequencies from dc to 100 cycles per second. The time delay is variable from 10 milliseconds to 10,000 milliseconds with an error of less than ± 5 milliseconds. The method of recording the information on tape is to convert it to digital form by means of analog-to-digital converters, record it in digital form, and then reconvert it to an analog voltage by means of a digital-to-analog converter. The device can handle 10 channels of information simultaneously.

ULTRASONIC DELAY LINE ANALYSIS
D. L. Schilling, et al., IRE Conv. Rec. Pt. 6, vol. 8, March 1960, p. 270/283.

A 600 - CHANNEL MEMORY UNIT FOR IMPROVING SIGNAL-TO-NOISE RATIOS
A. L. Broadfoot, et al., Saskatchewan U. (Canada), Scientific rept. no. CR-5, May 1961, 33 p., incl. illus., AD 289 564.

An ultrasonic delay-line memory unit was constructed to add and store successive spectra obtained from a rapid-scanning auroral spectrometer. . . . The memory is divided into more than 600 ten-digit channels with a capacity of 2 to the 10th -1 counts per channel. . . .

EDDYCARD MEMORY –A SEMI-PERMANENT STORAGE
K. Nagamori, et al., Proc. Eastern Joint Comp. Conf., Dec. 1961, p. 194/209.

THEORY OF ULTRASONIC DELAY LINES FOR DIRECT-CURRENT PULSE (In Japanese)
M. Onoe, J. Inst. Elect. Commun. Engrs. Japan, vol. 44, no. 1, Jan. 1961, p. 29/36.

. . . analysis. . . based on equivalent circuits . . . applicable to lines with either piezoelectric or magnetrostrictive transducers and using either longitudinal or torsional waves. . . .

BIBLIOGRAPHY ON MAGNETOSTRICTIVE DELAY LINES
A. Rothbart: IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 285, 37 refs.

BIBLIOGRAPHY ON MAGNETOSTRICTIVE DELAY LINES (Correspondence)
A. Rothbart, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961. p. 285.

. . . has been compiled from many technical publications in this country and abroad, covers a wide area in theory, design, and application.

IMPROVED DELAY LINE TECHNIQUES
S. W. Tehon, et al., General Electric Co., Syracuse, N. Y., RADC TR 61-57, Final rept. Jan. 1961, 110 p., AD 254 700.

TRANSIENT PROCESSES IN DELAY LINES WITH A LARGE NUMBER OF M-DERIVED SECTIONS
B. V. Yelizarov, et al., Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 10, 1961, p. 8/17.

VARIABLE TIME DELAY BY PADE APPROXIMATION (Correspondence)
D. L. Zackon, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 783.

. . . In this note, Pade approximation was used to get the desired time delays. However, the ratios which involved the delay were not fixed by potentiometers, but were generated by servo dividers.

A BUFFER STORE FOR DATA TRANSMISSION
W. E. Baker, et al., Commun. and Electronics, vol. 80, no. 58, Jan. 1962, p. 566/570.

A method is presented for connecting an information source emitting data at an arbitrarily fluctuating rate to a synchronous transmission system. Expressions are derived relating the fluctuating input data rate and the maximum transmission efficiency to the capacity of a buffer store necessary to establish this connection. An acoustic delay line buffer store whose input and output are independent of each other is described. The buffer store has a capacity of 45 bits, operates with 2 μsec. (microsecond) spacing between pulses, and employs a unique method of generating a 500-kc timing signal. . . .

A BUFFER MEMORY FOR SYNCHRONOUS DIGITAL NETWORKS
C. J. Byrne, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 138/142.

The functions of switching and time multiplexing in large digital communications networks are made easier if all the signals at a station are timed and framed in agreement with a local clock and all the clocks in a network are in synchronism. However, the arrival times of signals are disturbed by jitter and variations in transmission delay. Therefore, buffer memories are required to bring incoming signals into agreement with the local clock. . . .

MAGNETOSTRICTIVE DELAY LINES FOR CARRIER FREQUENCY SIGNALS (In German)
G. Freiburger, Nachrichtentechnik, vol. 12, no. 8, Aug. 1962, p. 286/293.

MAGNETOSTRICTIVE DELAY LINES (Correspondence)
G. S. Glinski, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 86.

ADVANCED RADAR RESOLUTION TECHNIQUES RESEARCH ON ULTRASONIC DELAY LINES
W. Konig, Electronics Research Lab., Columbia U., New York., Final rept. 1 Oct. 1958-31 March 1962, Rept. no. F/178 (F/152; RADC TDR 62-216, vol. 1, 31 March 1962, 49 p., incl. illus., 19 refs., AD 285 222.

. . . to improve the performance and reliability characteristics of wide-bandwidth, low distortion, polygonal type lines. . . . development of new techniques . . .

ULTRASONIC DELAY LINE DEVELOPMENT
L. Lambert, Electronics Research Labs., Columbia U., New York, Technical progress rept., 1 July - 31 Dec. 1961, Technical rept. no. P-1/178; CU-1-62-AF-1113-ERL, 2 Jan. 1962, 43 p., AD 271 710.

. . . lead as a bonding and backing material. . . . experimental results. . . . Design techniques for polygonal delay lines. . . . A theoretical analysis, based on Fresnel diffraction theory . . . results in the determination of the optimum transducer length for minimum spurious response level.

THEORY OF ULTRASONIC DELAY LINES FOR DIRECT-CURRENT PULSE TRANSMISSION
M. Onoe, J. Acoust. Soc. Amer., vol. 34, no. 9, Sept. 1962, p. 1247/1254.

IMPROVED DELAY LINE TECHNIQUES
S. W. Tehon, et al., General Electric Co., Syracuse, N. Y., Final rept. RADC TDR 62-238, June 1962, 97 p., incl. illus., tables, AD 282 754.

. . . dispersive ultrasonic delay lines . . . thin ferroelectric ceramic sheet lines. . . . a number of novel configurations . . . relatively small time delay - bandwidth products . . . large numbers of taps. . . .

INVESTIGATION OF SOLID-STATE DELAY LINES
Kaiser Industries Corp., Palo Alto, Calif., Final rept., 30 April 1962, 107 p., incl. illus., AD 275 764.

Research was conducted on solid-state display circuitry. . . . various types of delay lines . . . nanosecond pulse techniques and pulsers . . .

THE SEMICONDUCTOR DELAY LINE AND RELATED DEVICES
Internat. Solid State Circuits Conf., no. 8.4, Feb. 1962.

. . . electronically variable delay. This is one integrated structure J.

MULTIPLE SYNCHRONOUS STORAGE OF PULSED SIGNALS
M. I. Finkel'shteyn, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 10, Oct. 1963, p. 13/19.

. . . Synchronous storage is widely used to achieve optimal extraction of a signal in the form of a packet of equally spaced pulses from a noise background. . . . shows a storage circuit comprising a delay line with a positive feedback loop, the time delay T_d being chosen equal to the pulse-repetition period of the required signal T_n. . . .

AN EXPERIMENTAL 600-FOOT ELECTROSONIC DELAY LINE FOR THE NAVY SPACE SURVEILLANCE SYSTEM
M. G. Kaufman, Naval Research Lab., Washington, D. C., NRL R5927, 22 May 1963, 12 p., AD 409 494, N64-15128.

. . . The requirement for delaying the composite (IRIG) FM telemetering signals from a Space Surveillance site by one-half second was fullfilled by converting the phone-line frequencies into sound, which is then transmitted through a pipe long enough to provide the desired delay . . .

AN EXPERIMENTAL 600-FOOT SONIC DELAY LINE FOR THE NAVY SPACE SURVEILLANCE SYSTEM
M. G. Kaufman, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 115/122.

. . . suggested that the recorders be turned on only during a satellite "pass" providing enough signal delay could be introduced so that the recorders could overcome their starting inertia. The requirement for delaying the composite (IRIG) FM telemetering signals from a Space Surveillance site by one-half second was fulfilled by converting the phone line frequencies into sound. . . .

TELEMETERING BUFFER STORAGE FOR SPACE VEHICLES
R. D. Kodis, Data Systems Engineering, vol. 18, Oct. 1963, p. 10/14, A64-11596.

Presentation of a sequential-access coincident-current 30,096-bit core memory with self-addressing and counting circuitry, designed to store data for telemetering in rocket and space-vehicle applications. . . . Data input and output are asynchronous, one bit at a time, at any rate up to 20,000 bits per second. The unit will operate in either the read/restore or the clear/write mode.

USE OF RECIRCULATORS FOR COMPRESSING FREQUENCY-MODULATED PULSES
V. V. Lebedev, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 11, Nov. 1963, p. 60/68.

The possibility of using circulating memory devices (recirculators) for the optimum extraction of a frequency-modulated pulse in noise is considered. A comparison with the usual filters using dispersive delay lines is carried out. . . .

A DELAY-LINE PUSH-DOWN LIST
P. A. Lord, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 872/874.

. . . uses a delay line as a storage device.

A SURVEY OF ANALOG MEMORY DEVICES
G. Nagy, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 388/393.

Related Publications:

A DELTA-SIGMA MODULATION SYSTEM FOR TIME DELAY AND ANALOG FUNCTION STORAGE
H. Handler, et al., Arizona Univ., Tucson, Jan. 1964, 41 p., AD 434 539.

. . . permits magnetrostrictive delay line function storage of analog data with the significant advantages of pulse regeneration with clock gated logic and relatively inexpensive conversion equipment. Five to 10 msec delay lines with a 2 mc bit-rate accommodate analog signals of up to 8 kc with phase shift below 2 degrees; total dynamic error is within 0.2% of half scale up to 1 kc. An adaptive filter permits a further trade off of accuracy for bandwidth during computation. . . .

3A.266: Various Other Memory Units

Included: Williams' tube memories; Electro-deposited twistor memory units; Bit-wire components; Metallic tape computer cores; Magnetic wire storage; Permanent magnet twistor memory; Semi-permanent storage by capacitive coupling; Unifluxor; Magnetic drum; Twistor memory; Diode capacitor memory; Magnetic rod storage device; Card random access memory (CRAM); Card capacitor.

Not Included: Twistor development.

Cross References: Electrostatic memory units (Barrier grid tube) (3A.263); Mass storage devices (3A.360).

Principal Publications:

A STUDY OF REFILL PHENOMENA IN WILLIAMS' TUBE MEMORIES
J. M. Maughmer, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 23/31.

. . . A dot-circle scheme is proposed which will permit the distinction between binary "0" and "1" signals when the stored information has been destroyed approximately 90 per cent by refill. This unusual recovery of stored information is accomplished by making proper choices of operating parameters and using discharging effects instead of the charging effects as has been done in the past.

MILLIMCROSECOND DIODE CAPACITOR MEMORY
M. M. Kaufman, Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 215/225.

. . . the cycle time for a diode capacitor . . . a prototype memory has been built to evaluate the difficulties in reducing the cycle time to approximately 10 millimicroseconds. . . .

NONDESTRUCTIVE READOUT OF METALLIC-TAPE COMPUTER CORES
L. M. Lambert, IRE Trans. Electronic Comp., vol. EC-8, no. 4, Sept. 1959, p. 470/474.

. . . by the application of a magnetomotive force spatially in quadrature to the direction of remanent flux. A simple method of fabrication is proposed and empirical data for the design of the nondestructive read systems is obtained.

ELECTRODEPOSITED TWISTOR AND BIT WIRE COMPONENTS
S. J. Schwartz, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 4, Sept. 1959, p. 465/469.

. . . a new device has been developed which requires no external stressing. This device has been designated as the "bit wire". The materials possess the desirable temperature stability usually associated with ferromagnetic metals and exhibit a high signal-to-noise ratio.

AN ELECTRICALLY ALTERABLE NONDESTRUCTIVE TWISTOR MEMORY
R. L. Gray, IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 451/455.

The twistor is a relatively new memory device which may be operated either in a conventional destructive read-out mode, or, by the method explained in this paper, in a nondestructive mode. This paper discusses the basic principles of twistor operation and shows how the twistor may be fabricated into a memory.

UNIFLUXOR: A PERMANENT MEMORY ELEMENT
A. Renard, et al., Proc. Western Joint Comp. Conf., May 1960, p. 91/96.

. . . an interesting permanent memory element. The technique used to vary the inductive coupling between the input and output . . . presents a fresh solution the problem of how to modulate this coupling.

A CARD-CHANGEABLE PERMANENT-MAGNET-TWISTOR MEMORY OF LARGE CAPACITY
W. A. Barrett, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 451/461.

. . . storage media for information that is infrequently changed. . . . special purpose computers are now being built which also contain a semipermanent memory from which the machine may only read information at high speed. Such a memory might be used for program or constants storage where the information content is seldom changed.

MAGNETIC MEMORY DRUM DESIGN
E. B. Carne, Commun. and Electronics, vol. 79, no. 52, Jan. 1961, p. 749/756.

CARD CAPACITOR–A SEMIPERMANENT, READ ONLY MEMORY
H. R. Foglia, et al., IBM J. Res. Developm., vol. 5, no. 1, Jan. 1961, p. 67/68.

Standard IBM cards, metalized and earthed, with punched through holes, inserted between special cards with printed circuits, form a capacitive memory. Holes correspond to "ones", no holes to "zeros". A single card represents 80 x 12 bits. Reading is done by applying high frequency voltage across printed cards. . . . access time form 0.1 to several microseconds. The memory can be altered by changing the punched cards. . . .

DRUM ORGANIZATION FOR STROBE ADDRESSING
G. L. Hollander, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 722/729.

. . . A comparison of various forms of strobe and conventional addressing shows that simple strobe addressing uses the memory as efficiently as conventional addressing if the problem can and must be solved in one revolution.

SEMIPERMANENT STORAGE BY CAPACITIVE COUPLING
D. H. MacPherson, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 446/451.

. . . A random-access store system where the memory elements consist of a matrix of printed capacitors has been developed. The store has a cycle time of 3 μsec and contains 1024 words each 34 bits long.

DESIGN AND OPERATION OF A HIGH SPEED INCREASED CAPACITY MAGNETIC DRUM
R. R. Schaffer, et al., IRE Internat. Conv. Rec., vol. 2, March 1961, p. 128/134.

A DIGITAL STATIC MAGNETIC WIRE STORAGE WITH NONDESTRUCTIVE READ-OUT
C. G. Shook, IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 56/62.

. . . a nonvolatile, digital, magnetic storage scheme is described, wherein binary words may be stored by magnetizing segments of a wire, and the information may be read out an unlimited number of times with no deterioration of the stored information. Two storage schemes are presented; a temporary, electrically addressed storage, and a permanent, program-type store.

THE DEVELOPMENT OF A NEW NONDESTRUCTIVE MEMORY ELEMENT
A. W. Vinal, Proc. Western Joint Comp. Conf., May 1961, p. 443/474.

This paper describes a two hole transfluxor in which both holes are made identical in size.

RESEARCH ON MAGNETIC ROD STORAGE AND CONTROL UNITS FOR A SWITCHING CENTRAL OFFICE
D. Rork, et al., National Cash Register Co., Hawthorne, Calif., Quarterly progress rept. no. 3, 15 Oct. - 14 Jan. 1962, Technical pub. no. 3405, 14 Jan. 1962, 34 p., incl. illus., table, AD 275 503.

. . . system specifications for a digital switching central . . . maximum use of high-speed magnetic logical and storage elements is feasible. . . . the use of multiplexed magnetic logic can produce functional circuitry with a minimum of active elements.

<u>3A.267</u>: Special Advanced Memory Units

<u>Included:</u> Thin magnetic film memory; Magnetic film store; Tunnel diode memory units; superconductive memory; Plastic neurons as memory elements; Cylindrical film memory; Maser memory element; Cryosar memory design; Persistor; Persistatron; Superconducting loop memory.

<u>Not Included</u>: Maser devices.

<u>Cross References</u>: Photo electric information storage (3A.263); Tunnel diode logic circuits (3A.224); Cryogenic computer technology (3A.206).

Principal Publications:

PLASTIC NEURONS AS MEMORY ELEMENTS
D. G. Willis, IRE WESCON Conv. Rec., no. 4, 1959, p. 55/65.

Studies of the logical elements, neurons, of the human brain carried out in order to construct machines capable of "pattern recognition" or "learning" are discussed.

CHARACTERISTICS OF A MULTIPLE MAGNETIC PLANE THIN FILM MEMORY DEVICE
K. D. Broadbent, et al., Proc. Western Joint Comp. Conf., May 1960, p. 97/103.

. . . utilizes the magnetic field associated with the divergence of the magnetization to achieve preferential arrangements of the magnetization vectors. . . . operates on the same magneto-static energy principle as the multiaperture ferrite core devices and represents a magnetic film embodiment of the ferrite-type device.

TUNNEL DIODE STORAGE USING CURRENT SENSING
E. R. Beck, et al., Proc. Western Joint Comp. Conf., May 1961, p. 427/442.

. . . describes a fast, small (64 words) tunnel-diode memory with predicted temperature limits at -55^{o}C and +125^{o}C. The work reported is a mixture of experiment and predictive analysis, and it shows that this type of memory has a limitation in that cycle time is proportional to N^2, where N is the number of words.

COINCIDENT-CURRENT SUPERCONDUCTIVE MEMORY
L. L. Burns, Jr., et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 438/446.

In a continuous superconductive film memory, elements are obtained through discrete regions of circulation of persistent currents near the intersection of x-y conductors deposited on the film. Analysis and confirming experiments show that these regions are stable. The elimination of edges of discrete film dots removes the main cause of variation of critical currents. Reproducibilities better than one quarter per cent were obtained. Simplicity of construction permits high bit densities. Advisable speed of operation depends mainly on addressing and sensing circuits. Write-in a 3 nsec was obtained in single elements with only 60 milliamperes drive.

CRYOSAR MEMORY DESIGN
R. C. Johnston, IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 712/717.

. . . The compensated cryosar is negative-resistance two-terminal device utilizing a bulk effect in germanium at liquid helium temperatures. Its bistable nature, and the ease with which it can be fabricated in large arrays recommend it for application to computer memory systems. . . .

A NON-DESTRUCTIVE READOUT FILM MEMORY
R. J. Petschauer, et al., Proc. Western Joint Comp. Conf., May 1961, p. 411/425.

PERSISTENT-CURRENT MEMORY CIRCUIT
W. C. Stewart, et al., Proc. IRE, vol. 49, Nov. 1961, p. 1681/1682.

. . . The persistor (or persistatron, the same circuit by a different name) is considered to be a superconducting loop, rather than a nonlinear resistor and inductor driven in parallel.

DEVELOPMENT AND FABRICATION OF STATIC DIGITAL MEMORY FOR COMMUNICATIONS SYSTEMS
R. M. Whitely, et al., National Cash Register Co., Dayton, Ohio, Final engineering rept., Oct. 1961, 143 p., AD 266 586.

. . . present state-of-the-art appears to lead to magnetic thin-film devices; one of which is the NCR Bit-Wire, a proprietary nonvolatile storage element. The Bit-Wire has excellent switching and storage characteristics for use in digital memory systems in aerospace environments. Bit-Wire was incorated into an experimental, word-organized, sequential-access, 400-bit memory system capable of operation over a temperature range of -55 to +81 degrees C. The silicon solid-state circuitry, the construction details of the delivered experimental model, and the logic techniques employed to obtain extremely low average power requirements are discussed.

MICROWAVE MEMORY TECHNIQUES PROJECT
R. J. Allen, Martin-Marietta Corp., Baltimore, Md., Final rept., Rept. no. ER 12579, RADC TDR 62-476, Sept. 1962, 1 v., incl. illus., tables, refs., AD 287 622.

. . . results of an 18-mo. study and experimental effort for development of a superconducting delay line . . . While the experimental effort did not yield a delay line of the desired capabilities (4- to 12-kmc bandwidth, 2-db loss and 20-microsecond delay), considerable improvement was obtained over room temperature lines, resulting in lines of useful, although lessened, capabilities. . . .

MAGNETIC THIN FILM MEMORY (FLUX LOGIC PERMALLOY SHEET MEMORY)
G. R. Briggs, et al., RCA Defense Electronic Products, Camden, N. J., Quarterly progress rept. no. 4, 1 April -30 June 1962, 30 June 1962, 1 v., incl. illus., tables, AD 284 390.

. . . detailed evaluation of an eight sheet, 128-bit per sheet, word-organized selection memory stack. . . .

LOW POWER THIN MAGNETIC FILM MEMORY
T. J. Matcovich, Remington Rand Univac Div., Sperry Rand Corp., Philadelphia, Pa., Interim engineering rept. no. 1, 5 April-5 July 1962, 5 July 1962, 14 p., incl. illus., table, AD 281 810.

A PRACTICAL NON-DESTRUCTIVE, RANDOM ACCESS TUNNEL DIODE MEMORY
J. Y. Payton, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 326/336.

A COMPACT 166-KILOBIT FILM MEMORY
R. D. Turnquist, et al., IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 63/72.

. . . The theory, design, and operating characteristics of a 166 thousand-bit thin film memory system are presented . . . Although this compact memory system is an integral part of a guidance and control computer designed specifically for an aerospace application, the design is adaptable to other military control computers. . . . random-access, parallel-readout, word-organized memory . . .

TUNNEL-DIODE MEMORY
J. M. Tyszka, Elect. Commun., vol. 37, no. 4, 1962, p. 387/397.

LOW POWER THIN MAGNETIC FILM MEMORY
Remington Rand Univac Div., Sperry Rand Corp., Philadelphia, Pa., Interim engineering rept. no. 2, 5 July - 5 Oct. 1962, 5 Oct. 1962, 31 p., incl. illus., tables, 4 refs., AD 286 391.

. . . feasibility of operating a magnetic thin film memory with currents of approximately 20 ma. . . . Unilloy I films with low dispersion but slightly higher anisotropy field being used.

. . . The use of deposited thin film active and passive elements was proposed as a solution to the connection problems for a large matrix. . . .

TUNNEL DIODE STORAGE SYSTEM WITH NON-DESTRUCTIVE READ-OUT
D. B. G. Edwards, et al., J. Brit. Instn. Radio Engrs., vol. 26, no. 5, Nov. 1963, p. 359/372.

. . . A brief survey of some tunnel diode storage systems is presented and a description of a particular system with a non-destructive read-out feature is given. . . .

OPERATION OF A MEMORY ELEMENT BASED ON THE MASER PRINCIPLE (Correspondence)
H. J. Gerritsen, Proc. IEEE, vol. 51, no. 6, June 1963, p. 934/935.

THE DESIGN OF A 4096-WORD ONE-MICRO-SECOND MAGNETIC FILM STORE
J. B. James, et al., J. Brit. Instn. Radio Engrs., vol. 25, no. 6, June 1963, p. 509/516.

. . . It is word-organized and bi-directional digit currents are used for writing. . . . A store-size ferrite core serves as the selection device for each word and a matrix of diodes directs the drive currents into the chosen lines of cores. . . .

CYLINDRICAL FILM MEMORY
N. F. Lockhart, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 197/208.

The orthogonal mode metal core (OMMC) is a nickel-iron film storage device in a cylindrical geometry. It is characterized by a short magnetic cycle and a large output. . . .

LOW-POWER THIN-MAGNETIC-FILM MEMORY
T. J. Matcovich, et al., Remington Rand, UNIVAC Div., Sperry Rand Corp., St. Paul, Minn., Final technical rept. 5 April 1962 - 22 April 1963, ASD TDR 63 661, Aug. 1963, 50 p., AD 415 068.

DIGITAL COMPUTER PERIPHERAL MEMORY
L. S. Onyshkevych, RCA Labs., Div., Radio Corp. of America, Princeton, N. J., Quarterly rept. no. 2, 1 Oct. - 31 Dec. 1963, 31 Dec. 1963, 61 p., AD 437 321, AD 428 012.

Continuation of work on a nonvolatile block-access high-capacity memory, which used coincidence of ultrasonic and electromagnetic pulses for read and write operations . . . required 10-nsec stress pulses with amplitudes of 0.1 to 1.0 kg/mm2 x-mm squared. Two approaches to a solution of this problem look promising: semiconductor depletion-layer transducers and electromagnetic high-current transducers. . . .

Related Publications:

CARD RANDOM ACCESS MEMORY (CRAM): FUNCTIONS AND USE
L. Bloom, et al., Proc. Eastern Joint Comp. Conf., Dec. 1962, p. 147/157.

. . . a radically new mass store, the NCR CRAM. The hardware and logic control features are discussed . . .

CRAM is a magnetic card storage module, having 256 magnetic cards within a magazine. Any card can be selected at random and wrapped around a rotating drum for information transfer (reading and writing).

PHOTOELECTRIC INFORMATION STORAGE
W. G. Reininger, et al., Westinghouse Electric Corp., Baltimore, Md., Interim engineering rept. no. 1, 1 June - 31 Aug. 1962, 31 Aug. 1962, 14 p., incl. illus., AD 291 551.

. . . design parameters of a tape camera storage tube. . . . on command erase the unwanted information and reuse the storage tape a great many times. . . .

LAMINATED FERRITE MEMORY
R. Shahbender, et al., RCA Rev., vol. 24, Dec. 1963, p. 705/729, A64-13635.

. . . a random-access magnetic memory consisting of monolithic ferrite sheet with integrated windings. . . . The resulting tightly packed elements with closed flux paths of only two to three mils in equivalent diameter, are the smallest yet realized by any technique. . . .

3A.268: Memory Units for Special Applications

Included: "Orthocore" memory; Memories for electronic switching centers; Satellite magnetic core memories.

Cross References: Special purpose data processors (3A.008).

Principal Publications:

A SIMPLE HIGH CAPACITY DIGITAL OUTPUT DATA STORAGE SYSTEM FOR SPACE EXPERIMENTS
V. E. Suomi, et al., IRE Nat. Symp. Space, no. 4-5, Sept. 1960, p. 1/9.

. . . for on board storage of data for use with satellite borne scientific experiments . . .

SYSTEM DESIGN CONCEPTS FOR SATELLITE MAGNETIC CORE MEMORIES
A. Egger, et al., Proc. Nat. Telem. Conf., vol. 2, no. 7-3, May 1962.

. . . Less than three years ago the first storage memory was launched into space. This formed a part of the STL digital telemetry unit (Telebit) which was flown on Explorer VI and later on Pioneer V. The capacity of the memory, which used transistors as memory elements was 120 bits. . . . The data storage unit to be discussed in this paper has a storage capacity of 10,000 bits and yet weighs far less than the memory of Telebit, is much smaller, and consumes less power. . . .

RESEARCH ON MAGNETIC ROD STORAGE AND CONTROL UNITS FOR A SWITCHING CENTRAL OFFICE INCORPORATING ADDENDUM MATERIAL
D. Rork, et al., National Cash Register Co., Hawthorne, Calif., Final progress rept., 15 April 1961-31 Oct. 1962, Rept. nos. 4 and 5, 31 Oct. 1962, 142 p., AD 297 793.

SOLID STATE MAGNETIC MEMORIES
D. W. Slaughter, JPL Space Progr. Summ., vol. 4, no. 31-19, Dec./Jan. 1962, p. 18/20.

Contracts have been initiated with two companies for the study of spaceworthy solid-state magnetic memories. . . . it is desirable to understand how this class of storage fits into the over-all requirement for science data storage and control.

PRIMARY PROCESSOR AND DATA STORAGE EQUIPMENT FOR THE ORBITING ASTRONOMICAL OBSERVATORY
T. B. Lewis, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 677/687.

. . . a low-power, long-life, high-density command and memory system has been designed and is currently undergoing qualification testing. The digital command storage and processing element will permit reprogramming of spacecraft orientation and astronomical experiments on each orbit, even when the satellite is not in contact with the ground, while the core memory element will permit storage of experiment data for subsequent transmission to the ground.

. . . the functional design of the satellite command and memory system is discussed in detail. In addition, the power conservation methods, reliability design techniques and environmental performance considerations which influenced the design of this equipment are reviewed.

AN AUTOMATED SEA SURVEILLANCE SYSTEM
N.S. Prywes, et al., Computer Command & Control Co., Philadelphia, Pa., Rept. no. 4 101 4, 1 Jan. 64, 70 p., AD 428 895.

. . . The study was conducted as a test case for evaluation of the usefulness of new concepts in computer memory organization generally, and the application of associative memories in particular.

"ORTHOCORE" — A LOW-COST NAVIGATIONAL COMPUTER MEMORY
J.S. Sallo, et al., Institute of Navigation, Low-Cost Navigation Symposium, Los Angeles, Calif., Nov. 6, 7, 1963, Paper, 15 p., A63-24950.

. . . is basically a magnetic core memory in which the cores are formed around the wires. It may be described as a memory of cored wires, rather than one of wired cores. . . .

Related Publications:

A KILOMEGABIT DATA ENCODING AND TRANSMISSION SYSTEM
D. Cohen, Nat. Comm. Symp. Rec., vol. 7, Oct. 1961, p. 69/74.

. . . involves the storing of a long time sample of an analog signal, simultaneously sampling the signal at a number of time positions, and converting each sample into digital form by parallel circuitry.

DIGITAL COMPUTER PERIPHERAL MEMORY
L.S. Onyshkevych, RCA Labs., Div., Radio Corp. of America, Princeton, N.J., Quarterly rept. no. 2, 1 Oct.-31 Dec. 1963, 31 Dec. 1963, 61 p., AD 437 321.

Continuation of work on a nonvolatile block-access high-capacity memory, which used coincidence of ultrasonic and electromagnetic pulses for read and write operations . . . required 10-nsec stress pulses with amplitudes of 0.1 to 1.0 kg/mm2 x-mm squared. Two approaches to a solution of this problem look promising: semiconductor depletion-layer transducers and electromagnetic high-current transducers. . . .

Section 3A.28: Special Engineering Problems for Data Processors

3A.282: Interconnections Between Units Within a Data Processor.

Included: Wiring problems in data processors; Transmission delay over interconnections: Coaxial cables as interconnections in computers.

Not Included: Theory of lines and cables; Packaging of computers.

Principal Publications:

ELECTRICAL ASSEMBLIES WITH A MINIMUM NUMBER OF INTERCONNECTIONS (Correspondence)
E.L. Lawler, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 86/88.

. . . This note is concerned with the problem of grouping together electrical subassemblies in such a way that the smallest possible number of electrical connections is required between the resulting assemblies.

NANOSECOND-PULSE DISTORTION IN A COAXIAL CABLE
G.V. Glebovich, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 10, Oct. 1963, p. 54/62.

Distortion of nanosecond pulses in transmission through a coaxial cable filled with solid polyethylene dielectric is considered. Results of an experimental investigation of the distortion of nanosecond video pulses are presented. . . .

THE EFFECTS OF INTERCONNECTIONS ON HIGH-SPEED LOGIC CIRCUITS
J.B. Jarvis, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 476/487.

By way of worked examples in typical but somewhat idealized cases the effect on circuit speed of circuit interconnections is studied. The source, calculation and minimization of interconnection crosstalk is also discussed. It is shown that high-speed circuitry must be miniaturized and the implications are discussed.

ANALYSIS OF SIGNAL TRANSMISSION IN ULTRA HIGH SPEED TRANSISTORIZED DIGITAL COMPUTERS
F.C. Yao, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 372/382.

The transmission of digital signals plays an important role in high speed computers, not only because the traveling time on the connecting wire is a significant portion of the total delay, but also because the wire is a distributed parameter coupling network which, as a transmission line, becomes an integral part of the computer circuitry and affects the over-all performance. . . .

Until recently, the interconnection problem in digital computers did not receive much attention. As the speed and size go up, the means of interconnecting calls for careful planning.

AUTOMATIC PROCESSING OF WIRING DATA
North American Aviation, Inc., Los Angeles, Calif., Bi-monthly rept. no. 3,20 Sept. - 30 Oct. 1963, Rept. no. NA63 783 2 , 1 Nov. 1963, 97 p., AD 427 886.

. . . to utilize procedures already established for production of Automatically Processed Wire Lists. Input data (signal codes) and output documentation (computer logic and formats) were designed to extend these procedures to include the Wire List-Systems . . .

Related Publications:

AN APPROACH TO AIRBORNE DIGITAL COMPUTER EQUIPMENT CONSTRUCTION
P. E. Boron, et al., IRE Trans. Prod. Techniques, vol. PT-4, June 1959, p. 18/21.

A method of building airborne digital equipment which makes use of the modularized etched-wiring plug-in philosophy and which utilizes an all-etched-wiring harness to accomplish the entire complex of connections between plug-in units is discussed.

3A.283: Error Control in Data Processors

Included: Error detecting codes for arithmetic operations; Error correction routines in data processing systems.

Not Included: Error correction codes (2).

Cross References: Automatic self-repair systems (3A.170); Diagnostic maintenance methods (3A.170).

Principal Publications:

ACCURACY CONTROL IN ELECTRONIC BUSINESS DATA PROCESSING SYSTEMS
J. C. Hammerton, Electronic Engng., vol. 30, Aug. 1958, p. 483/486.

A general design philosophy . . . Three types of checks (feedback, parity, and verification) necessary to ensure reliable communication between the individual parts of the system are described, and the detection, correction, and indication of errors in the individual machines are considered.

AN IDEALIZED OVER-ALL ERROR-CORRECTING DIGITAL COMPUTER HAVING ONLY AN ERROR-DETECTING COMBINATIONAL PART
W. L. Kilmer, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 321/325.

The block diagram of an idealized over-all error-correcting digital computer is presented. . . . property that during each unit time interval, it can correct the effects of a specific maximum number of transient-type component failures which might occur anywhere within it. Yet, all its combinational logic circuitry is only of the error-detecting type.

APPLICATION OF ERROR-CORRECTING CODES TO MULTI-WAY SWITCHING
H. Takahasi, et al., Proc. Internat. Conf. Inform. Processing, June 1959, p. 396/400.

. . . describes a switching circuit for selecting one of a number of outputs. It uses a linear network of transformers to couple the drivers to threshold elements, and the connections are determined according to an error-correcting code. The application to the selection circuits of a parametron memory, in operation since May, 1958 is briefly described.

ERROR DETECTING AND CORRECTING BINARY CODES FOR ARITHMETIC OPERATIONS
D. T. Brown, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 333/337.

The most important property of the codes derived in this paper . . . makes possible the detection and/or correction of errors committed by the arithmetic element of a computer. In addition, messages can be coded and decoded and errors can be detected and corrected by arithmetic procedures, making it possible to eliminate some or all of the special-purpose equipment usually associated with error-detecting or correcting codes. This property may make these codes useful for data transmission as well as for computation.

CODES AND CODING CIRCUITRY FOR AUTOMATIC ERROR CORRECTION WITHIN DIGITAL SYSTEMS
W. H. Kautz, In Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 152/195.

A fairly extensive survey of error detection and correction codes is made with a view toward selecting those which are best suited for implementation within a digital system. The emphasis is on attaining minimal complexity of the coding and decoding circuits. Hamming codes, cyclic codes, Berger codes and others are discussed and various circuits are developed for implementing with relays or gate elements, in serial or parallel modes.

ERROR-CORRECTING CODES APPLIED TO COMPUTER TECHNOLOGY
J. L. Massey, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 142/147.

The modes of communication encountered with modern digital computers can be classified as inter-machine, e.g., a data link between computing centers, and intra-machine, e.g., transfer of data from the memory unit to the arithmetic unit. The error-correction requirements of each mode are discussed and specific techniques suitable for immediate implementation are developed from existing coding techniques . . .

Related Publications:

USE OF "OR" IN A DATA-PROCESSING OPERATION
R. L. Smith, et al., Operations Research, vol. 11, Sept.-Oct. 1963, p. 818/822.

Presentation of an OR type procedure for developing decision criteria. The criteria determine whether to reprocess data through an automatic digital computer or use error-correction routines to modify incorrect results. . . .

DIVISION 3A.3
PERIPHERAL DEVICES FOR DATA PROCESSING IN SPACE SYSTEMS

Peripheral equipment in space information processing systems involves quite different problems than standard input-output equipment for commercial data processing installations.

This division attempts to present sets of carefully selected references about those technologies and devices which are most different from their counterparts in DP installations. To avoid exceeding the planned size of this bibliographical volume, it was necessary to exclude most references to conventional DP equipment such as card readers, printers, punches, etc. The references to special, space oriented input/output devices have been selected according to their potential value as further sources of specialized information. Bibliographies, surveys and introductory articles have been preferred, when available. Care has been taken to include at least a few references about any particular technological area; of the many hundreds of references in the sensor, recorder and display fields, the compilers sought to select those which were directly linked to practical space applications.

The organization of this division centers around three areas; Input devices, recording techniques and display systems. Digital input equipment is of fairly conventional design and only a few references are presented in section 3A.32. Books and surveys about general DP equipment (sect. 3A.00) may fill this gap. Practically all input information reaches the space data processors in analog form and it will either be processed by analog techniques or it will be converted to digital form for further processing (see Div. 3A.5). Analog sensors (3A.33) or complete input subsystems (3A.34) are therefore the principal input sources. They accept information in practically all forms of physical modes of energy transfer, from mechanical inputs to thermal energy, to radiations of all frequencies or kinds of particles and to magnetic fields and seismic pulsations. Correspondingly there are several subdivisions about such individual sensor elements within section 3A.33. However the requirements for information acquisition by space craft are so complex that in many cases they cannot be fulfilled by a simple one-dimensional sensor element, however accurate and sensitive it may be. Large and complex sensor subsystems are already in operation for performing such acquisition tasks as navigational observation, picture inputs and scientific reconnaissance about other celestial objects. Section 3A.34 contains several subdivisions with references to such complex analog and hybrid sensor subsystems. Character readers are apparently the only "earth oriented" sybsystems of this kind (3A.342).

There are two sections, on recording techniques (3A.35) and on recording equipment (3A.36), which concentrate primarily on tape recording engineering for space applications. Again, it was not possible to include references to conventional mass-storage devices, such as tape stands or magnetic disc units. Since many specially designed tape recorders have been used in space craft for the semi-permanent conservation of analog and digital data, references to these developments have been included.

Two other sections deal with output devices. Mechanical output devices are more closely related to conventional DP output equipment, such as printers and plotters (3A.37). However the real time character of the space data processing activities makes it essential that the results of computations and machine evaluations must be presented to the control personnel instantaneously and in the most accessible form. Complex and extended display subsystems are in use in the various space command centers, but also in space craft cockpit systems. Section 3A.38 attempts to review the literature in this rapidly expanding field.

Section 3A.30

3A.300: General References to Peripheral Devices

Included: Data collection systems; Data handling systems; Networks of peripheral equipment.

Not Included: Data transmission equipment; Data transmission methods (1); Encoding methods (2).

Cross References: Data acquisition systems (3A.340); Instrumentation and sensor devices (3A.330).

Principal Publications:

NEW DESIGN PHILOSOPHIES IN DYNAMIC DATA HANDLING SYSTEMS
J. J. Dover, Proc. Nat. Symp. Telem., no. 5.3, Sept. 1958.

. . . systems devoted to processing scientific test data. . . . "processing", handling", and "computation of data". . . . definition of terms . . . processing and computation effort together are defined as "data reduction" while the three blocks together are defined as "data handing". By "data acquisition" we mean the equipment required to collect and sense data and transform it into a coded signal suitable for recording. . . .

DIGITAL APPLICATIONS OF MAGNETIC DEVICES
A. J. Meyerhoff, Sr. (Editor), New York, John Wiley & Sons, Inc., 1960, 623 p.

. . . material which was only available scattered throughout a large number of technical journals and convention records.

RECOGNITION, IDENTIFICATION AND DATA PROCESSING
M. J. Anderson, Hughes Aircraft Co., Culver City, Calif., Final Technical rept., Rept. no. TM-704, AFCRL 62-170, March 1962, lv., incl. illus., tables, AD 278 566.

. . . new sensor and data processing techniques applicable to the recognition of non-cooperative aerospace vehicles . . . The methodology is applicable to evaluating or optimizing different system configurations and operational procedures. A decision procedure and the appropriate data processor applicable to aerospace vehicle recognition is discussed. . . . The representative sensors chosen are the ground based R-F signal interceptor and the IR-visual appearance-behavior sensor.

INPUT/OUTPUT EQUIPMENT FOR RESEARCH APPLICATIONS
W. S. Holmes, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 509/517.

. . . Research problems arising in the areas of photointerpretation, pattern recognition, speech analysis and radar signal analysis are described with examples of specific solutions of these problems in terms of input/output equipment. This paper, in addition, demonstrates that access to a special input/output system will permit for the solving of research problems, a radically different approach which is not ordinarily evident at the outset of an investigation.

DATA COLLECTION SYSTEMS, THEIR APPLICATION AND DESIGN
J. A. Pearce, J. Brit. Instn. Radio Engrs., vol. 24, no. 6, Dec. 1962, p. 489/496.

A distinction is drawn between two types of data gathering systems. Possible applications for one of these, namely data collection systems, are discussed. . . . two types . . . are described . . . This paper is not concerned with the high-speed point-to-point transmission of data but rather with a particular class of multiple-input low-speed data gathering systems. . . .

Section 3A.31

3A.310: Organization Data Processing Networks

Included: Systems engineering of connecting peripheral equipment; Multiplexing special purpose accessories to a digital computer; Connecting randomly timed input and output devices; Queueing problems with peripheral equipment.

Not Included: Switching centers.

Cross References: Queueing theory (3A.115); Organization of computer systems (3A.130).

Principal Publications:

REALIZATION OF RANDOMLY TIMED COMPUTER INPUT AND OUTPUT BY MEANS OF AN INTERRUPT FEATURE . . .
L. R. Turner, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 141/149.

COMMUNICATIONS FOR PRIVATE WIRE DATA PROCESSING
G. O. Vincent, Computers and Automation, vol. 7, Sept. 1958, p. 14/18.

Several private wire data transmission and communications systems specially designed by the Western Union Telegraph Company are briefly described. The descriptions include the purpose and operation of the systems and the equipment used in them.

ESTIMATION OF DUPLEX COMPUTER DEPENDABILITY FROM SIMPLEX DATA
J. Gold, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 385/390.

. . . The SAGE system provides an example of the duplexing principle in operation. This system utilizes the AN/FSQ-7, a large-scale duplexed digital computer system. It is an integral part of the Air Defense operation and is intended for continuous operation . . .

ANALYSIS OF A BASIC QUEUEING PROBLEM ARISING IN COMPUTER SYSTEMS
P. E. Boudreau, et al., IBM J. Res. Developm, vol. 5, April 1961, p. 132/140.

. . . difficult queuing problem which arises in a simplified model of the input-output area of a computing system. Data from a number of simulations is presented which is in good agreement with their theoretical results.

A MATHEMATICAL MODEL FOR INPUT-OUTPUT DEVICES AND THEIR CONNECTIONS
L. Calabi, et al., Parke Mathematical Labs., Inc., Carlisle, Mass., Rept. no. SR5, Nov. 1963, 62 p., AD 430 819.

WHEN IS REAL TIME REALLY TIMELY?
J. Moshman, et al., Proc. Nat. Telem. Conf., vol. 2, no. 11-1, May 1962.

MULTIPLE INPUT-OUTPUT LINKS IN COMPUTER SYSTEMS
B. B. Tasini, et al., IBM J. Res. Developm., vol. 6, July 1962, p. 306/328.

This paper attempts to optimize the capacity and configuration of external buffers for the input-output channels of a digital computer for the purpose of obtaining maximum data transfer and information source usage.

AN ANALOG INPUT AND OUTPUT SYSTEM FOR A REAL-TIME PROCESS CONTROL COMPUTER SYSTEM
C. A. Walton, Proc. Joint Automatic Control Conf. (section 13), 1962, p. 7/12.

. . . a brief technical report on the input and output features of the IBM 1710 Process Control System. . . . described: the analog signal multiplexer, the analog-to-digital converter, noise filter, thermocouple compensation, contact sensing and operating, program interrupt, and analog output. . . . Intended as an input/output system for the IBM 1620 computer . . .

THE CITAC COMPUTER SOLVES PROBLEMS REMOTELY (In French)
A. Ameau, et al., Onde Electr., vol. 43, no. 431, Feb. 1963, p. 231/242.

. . . describes a data transmission system specially designed to work between the CITAC computer and a number of remote stations, the distance between them being in many cases several hundred kilometers.

A METHOD OF DATA ACQUISITION AND SYSTEM CONTROL THROUGH TIME SHARING OF MIXED INPUTS
B. Brentnall, et al., Stanford U., Calif., Feb. 1963, 39 p., N63-17035.

. . . a design for an inexpensive, mobile, accurate, broad-spectrum data-acquisition system with digital readout and control capability. It will accept the outputs from a wide range of common transducers, scan them at a rate up to 5 per second, and process them to an overall accuracy of at least 99.53%.

DATA TREATEMENT USING NUMERICAL TRANSMISSION OVER LONG DISTANCES (In French)
A. Desblache, Onde Electr., vol. 43, no. 431, Feb. 1963, p. 243/250.

. . . data collecting systems, systems suitable for direct use and finally message exchangers . . . Each equipment is examined in particular in the light of all the various criteria, namely - speed of efficiency, reliability or number of undetected transmitted errors . . . The conclusion emphasizes that this technique is still very much in evolution and that important developments can be expected in the years to come.

THE EURATOM COMPUTER LINKAGE SYSTEM
C. Green, Italy Sci. Data Processing Center, EUR-284, e; CETIS Rept. 40, 1963, 11 p., Available from Belgian American Ban Trust Co., N. Y., account, No. 121.86; N63-19915.

This report describes a project for the construction of a system for the linkage of digital and analog computers. It proposes two principles hitherto unused in this field, namely an asynchronous system for the regulation of the passage of data from the analog computer to the A-D converters, and an interpolation system at the output of the digital computer. . . .

MESSAGE BUFFERING IN A COMPUTER SWITCHING CENTER
G. Harrison, IEEE Trans. Commun. Electronics, no. 68, Sept. 1963, p. 532/534.

. . . The extreme cases of individual as against shared-line buffering are analyzed under the assumption of exponentially distributed message lengths. Finally, a method is indicated for increasing the accuracy of estimates of required storage capacity when the distribution of message lengths is known.

MATCHING COMMUNICATION FACILITIES TO DATA PROCESSORS
C. F. Haugh, et al., IEEE Trans. Commun. Electronics, no. 67, July 1963, p. 429/435.

. . . There are a number of problems which arise when data-processing equipment is to be connected to communications lines in real-time systems. Four different solutions. . . . are discussed. . . . the choice depends on the system complexity and size, information flow rates, and the central processor requirements.

DELAY IN DATA TRANSMISSION THROUGH SIMPLE NETWORKS: STEADY STATE STATE CHARACTERISTICS WITH INFINITE NODAL STORAGE
B. J. Moriarty, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 25G19, 6 June 1963, 40 p., AD 408 250.

. . . single constant rate source of data communicating with a single sink of data, via a set of fault-liable HF links which are connected to relay stations equipped with storage facilities. Methods of transmission are used between nodes which effectively result in a node ceasing to transmit when a link becomes faulty and only resuming when a link returns to its normal condition. Thus data will queue at a node when the outgoing link is faulty, and all data reaching the sink is error-free. The network has been simulated on a digital computer using the recorded link behavior of two existing HF RTTY links. The probability distributions have been obtained for the queues that arise at the nodes and for the total delay involved in transmitting data from the source to the sink.

MULTIPLEXING SPECIAL PURPOSE ACCESSORIES TO A DIGITAL COMPUTER
Y. K. Puri, Illinois Univ., Urbanan Engineering Experiment Station, Rept. nos. RRL218, TR21, 20 Sept. 1963, 31 p., AD 423 822.

Related Publications:

ANALYSIS OF DELAY IN MATHEMATICAL SWITCHING MODELS FOR DATA SYSTEMS
D. G. Haenschke, Bell Syst. Tech. J., vol. 42, no. 3, May 1963, p. 709/736.

Traffic delay, caused by temporary all-lines-busy conditions, is analyzed for three mathematical switching models. . . . Each model assumes that a message is switched only through one switching center which must establish connections via line groups to one or more addressed receiving stations, i. e., each model contains only a single switching center. Numerical results for the average delay on all messages are obtained on the IBM 7090 computer.

Section 3A.32

3A.320: Digital Input Equipment

Included: Card readers; Tape readers; Coded letter sorting machines; Keyboard operated input systems; Digikey input device; Mechanical digital code generator; Stenowriter; Digital transducer techniques.

Not Included: Electric typewriters.

Cross References: Communicating typewriters (3A.392); Electromechanical transducers (analog type) (3A.332).

Principal Publications:

THE TRANSPORT OF PAPER TAPE IN DIGITAL COMPUTATION
A. D. Booth, J. Brit. Instn. Radio Engrs., vol. 20, no. 9, Sept. 1960, p. 657/660.

Using the principles of elementary dynamics limits are put on the speeds with which a paper transport mechanism which is required to stop at a given character can be expected to work. It is shown that these speeds are nearly four times those so far achieved. . . .

A NEW 600 CARDS PER MINUTE CARD READER
H. H. G. Groom, J. Brit. Instn. Radio Engrs., vol. 20, no. 9, Sept. 1960, p. 669/674.

. . . card transporting mechanism . . . novel stacking . . . Two systems of card sensing . . . one using photo-transistors, the other silicon photo-voltaic cells. . . .

A HIGH-SPEED TAPE READER
R. D. Lacy, J. Brit. Instn. Radio Engrs., vol. 20, no. 9, Sept. 1960, p. 661/668.

At speeds of 1,000 characters/sec, photoelectric sensing of the information is essential and the mechanical control of the tape should be as simple and as free from inertial forces as possible. An electro-magnetic brake and clutch are operated from a photo-transistor sensing the position of the sprocket hole to locate the tape in the reading positions. . . . The optical system permits accurate reading of tape on which the holes are incorrectly positioned relative to the edge. Functional tests show that the accuracy and reliability of the reader in service is of a very high order. Over 10^6 characters have been read from standard pattern loops without detecting an error.

USE OF PHOSPHORESCENT CODE MARKS IN AUTOMATIC LETTER-FACING AND SORTING MACHINES
C. F. Forster, Post Off. Elect. Engrs. J., vol. 54, no. 3, Oct. 1961, p. 180/185.

AUTOMATIC KEY-BOARD OPERATED MORSE-CODE SYSTEM WITHOUT TAPE
R. W. Johnson, Conv. Rec. Global Communications, vol. 5, 1961, p. 197/199.

DIGIKEY - A KEYBOARD TECHNIQUE FOR DIGITALIZING HUMAN INFORMATION
S. G. Lutz, Conv. Rec. Global Communications, vol. 5, 1961, p. 200/205.

THE STENOWRITER - A SYSTEM FOR THE LEXICAL PROCESSING OF STENOTYPY
E. J. Galli, IRE Trans. Electronic Comp., vol. EC-11, No. 2, April 1962, p. 187/199.

. . . utilizes a special-purpose translation computer, equipped with a large random-access memory, to provide real-time processing of spoken material into typewritten English. The input is provided by an operator using a special keyboard with which information may be stencgraphically encoded as rapidly as it is spoken. The stenographic code is automatically processed by the translation system into corresponding English with proper spelling and format. The output appears on an electric typewriter. Through multiplexing techniques, information for a large number of input-output units can be processed, each on a real-time basis, by one computer.

SUBMINIATURE KEYBOARD OPERATED DIGITAL CODE GENERATOR FOR DEEP SPACE COMMUNICATIONS
R. W. Johnson, Proc. Nat. Winter Conf. Mil. Electronics, vol. 2, no. 16, 1963, p. 27/30.

DEVELOPMENT OF A HIGH SPEED PAPER TAPE READER
K. R. Rosolen, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 12, Dec. 1963, p. 866/870.

This paper describes the design and construction of a 1000 characters/s, 50 to 8 hole paper tape reader. Basic requirements rather than variations of present systems were used in specifying much of the design, though some advantages over present systems are descussed. The resulting reader was a reliable device with comparable start and stop times due primarily to the clutch design having an inherently fast response. The control circuits are fully transistorized and are also included in the description. . . .

Section 3A.33
Analog Input Devices (Transducers)

3A.330: Input Instrumentation in General

Included: Meteorological instrumentation for weather data processing systems; Surveys of sensor development; Space instrumentation; Flight test instrumentation; Transducers in general; Proximally located instrumentation.

Not Included: Design and development of instruments; Theory of measurements; Instrument technology.

Cross References: Larger sensor subsystems (3A.340); Electromechanical transducers (3A.332); Thermo transducers (3A.333).

Principal Publications:

INSTRUMENTATION USED FOR IONOSPHERE ELECTRON DENSITY MEASUREMENTS
W. J. Cruickshank, Conf. Proc. Nat. Conf. Mil. Electronics, vol. 4, June 1960, p. 497/502.

FLIGHT TEST INSTRUMENTATION
M. A. Perry (editor), New York, Pergamon Press, 1961, 153 p.

. . . Instrument transducers. . . . aircraft telemetry system . . . magnetic tape recording in flight testing . . . Aircraft data reduction techniques. . . . 15 papers listed comprise the edited Proceedings of the First International Symposium sponsored by the Department of Flight, College or Aeronautics, Cranfield, in 1960. . . .

USERS TELEMETRY TRANSDUCER WORK SHOP. MINUTES OF THE SECOND MEETING, 25-26 July 1961, HOLLOMAN AFB, NEW MEXICO
W. M. Saunders, et al., Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex., 1961, 177 p., incl. illus., tables, AD 276 639.

INSTRUMENTATION
F. K. Kirk, et al., Chicago, Ill., American Technical Society, 1962, 264 p., A63-17054.

. . . introductory textbook. . . . latest developments in measurement, control, and analysis instrumentation. . . .

THE MEASUREMENT OF SURFACE MOTION BY MEANS OF PROXIMALLY LOCATED INSTRUMENTATION: AN ANNOTATED BIBLIOGRAPHY
C. M. Pierce (comp.), Lockheed Aircraft Corp., Sunnyvale, Calif., Bibliography for 1930-June 1962, Special bibliography no. SB 62-36; Rept. no. 3-80-62 24, Nov. 1962, 35 p., 93 refs., AD 296 371.

. . . instruments . . . include: accelerometers, velocity meters, contact circuitry, capacitance techniques, Doppler techniques, high speed photography and radiography, pressure transducers, and strain gauges.

SOME GENERAL FEATURES OF DIGITAL DATA ACQUISITION SYSTEMS
E. B. Stuttard, J. Brit. Instn. Radio Engrs., vol. 24, no. 4, Oct. 1962, p. 263/267.

. . . use of a single measuring system to obtain data from many inputs and record the results for future use. Such systems usually accept analogue inputs and incorporate equipment for conversion to digital form. A typical system is described. . . .

TELEMETRY TRANSDUCER HANDBOOK
H. F. Fisher, Jr., Radiation, Inc., Melbourne Fla., WADD TR61 67, vol. 1, rev. 1, Sept. 1963, 599 p., AD 421 951.

. . . The characteristics are discussed of the transmission system and its relation to transducers and telemetry systems. A guide is presented to more specialized investigation of the many aspects of telemetry systems. The fundamentals involved in various physical measurements and how these fundamentals are employed in the general design of transducers are presented. . . . General information and examples in the application of telemetry transducers are presented. . . . An extensive bibliography is presented with 835 listings. . . .

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY, VOLUME 3: METEOROLOGICAL SENSORS
Republic Aviation Corp., Farmingdale, N. Y., Final Report, 17 June 1963, 187 p., refs., N64-17697.

The meteorological sensor study in this volume sets forth the essential considerations and requirements for the cloud-cover and heat-budget sensory systems for the synchronous meteorological satellite . . . Comparative data are presented on various photosurfaces, photoemissive tubes, and photoconductive tubes, as well as hybrid and special types of tubes. Included among the topics discussed are heat-budget measurement and infrared cloud cover sensors.

Related Publications:

FIELDS AND PARTICLES EXPERIMENT FOR RANGERS 7, 8, 9
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 53/61.

Ionization Chamber . . . Particle Flux Detector . . . Dust Particle Experiment . . . Search Coil Magnetometer . . . Low Energy Ion Detector. . . . Electron Flux Detector . . . Electron-Proton Spectrometer . . . Low Energy Solar Protons . . .

SPACE MEASUREMENTS FOR DEFENSE ATOMIC SUPPORT AGENCY. PART I, SATELLITES AND SPACE PROBES
Electro-Optical Systems, Inc., Pasadena, Calif., Rept. no. EOS1890A, 1 July 1962, 1 v., AD 415 161.

SENSORS FOR ARMS CONTROL: A SURVEY OF RECENT TECHNICAL DOCUMENTATION: VOL. 1.: ENUMERATIVE BIBLIOGRAPHY. VOL. II: INDEX
D. W. Hill, North American Aviation, Inc., Downey, Calif., Rept. nos. SID 63 6251, SID 63 6252. 1 Aug. 1963, 1 v., AD 421 542.

3A. 332: Electromechanical Transducers

Included: Stress transducers; Ferrite piezo-magnetic transducer; Low input conversion; Position and velocity servos; Liquid gauges; Accelerometers; Electromechanical pick-ups; Electrostatic transducers; Variable inductance transducers; Force sensing transducers; Piezo electric converters; Variable reluctance transducers; Resolvers; Synchro data converters.

Not Included: Electroacoustical transducers; Microphones; Record cartridges (pick ups).

Cross References: Digital transducer techniques (3A. 320).

Principal Publications:

A MINATURIZED SYNCHRO DATA CONVERTER WITH A TWO-SPEED OUTPUT DESIGNED FOR AIRBORNE TELEMETERING APPLICATIONS
R. B. Owen, Nat. Symp. Telem., no. 4.4, Sept. 1958.

THE SYNCHRO RESOLVER AS A SHAFT POSITION TRANSDUCER
M. B. Wood, Electronic Engng., vol. 30, June 1958, p. 366/370.

THE DESIGN OF POSITION AND VELOCITY SERVOS FOR MULTIPLYING AND FUNCTION GENERATION
E. O. Gilbert, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 391/399.

VARIABLE-RELUCTANCE DC TRANSDUCER
O. K. Kowallis, Nat. Telem. Conf., May 1959, p. 181/187.

EMKOSTNYE DIFFERENTSIAL'NYE DATCHIKI PEREMESHCHENIIA (Capacitive Differential Movement Pickups) (In Russian)
V. A. Atsiukovskii, Gosenergoizdat, Moscow-Leningrad, 1960, 103 p.

. . . devices for measuring movements by electrical means. Examples of their design . . . Recommendation . . . about the construction of a.c. follow-up systems . . . for engineerings and technicians . . .

ULTRASONIC LIQUID-LEVEL GAUGING
D. E. Gross, Missile Design & Developm., vol. 7, no. 2, Feb. 1960, p. 30/33.

With the advent of the space age, the ability to measure liquid level reliably and accurately became a matter of prime importance. The variety of environments (from ICBM liquid oxygen to nuclear reactor sodium) and the almost infinite variations in liquid characteristics, made the development of new gauging techniques mandatory. . . .

FORCE SENSING TRANSDUCERS FOR TELEMETERING
J. S. Hernandez, Proc. Nat. Telem. Conf., May 1960, p. 317/342.

USE OF VARIABLE INDUCTANCE TRANSDUCERS IN A TELEMETRY SYSTEM
M. J. Kopp, Proc. Nat. Telem. Conf., May 1960, p. 657/669.

INERTIAL ACCELEROMETERS - THEIR NATURE, CHARACTER, AND LIMITATIONS
M. Maurer, Conf. Proc. Nat. Conf. Mil. Electronics, vol. 4, June 1960, 403/412.

TRANSDUCER EVALUATION - A SPACE AGE TOOL
G. Von Vick, Proc. Nat. Telem. Conf., May 1960, p. 301/316.

. . . Knowing that many variables exist in the instrumentation of a missile, Lockheed MSD instituted a program of transducer research and evaluation, closely paralleling the National Bureau of Standards evaluation effort. To date, the cost and effort expended has been more than paid for the results of this program.

TRANSDUCER EVALUATION
G. Von Vick, Instruments & Control Systems vol. 33, no. 6, June 1960, p. 979/981.

DIGITAL TRANSDUCER RESEARCH PROGRAM 5935-M
J. R. Wullert, et al., Engineering Development Lab., Naval Air Development Center, Johnsville, Pa., Annual progress rept. no. 1, 14 Dec. 1960, 33 p., AD 415 046.

. . . to transform transducer rectilinear motion into a parallel binary pulse code by magnetic reluctance techniques. This noncontact technique generates digital signals representing the mechanical displacement of a magnetic armature, by successively altering the state of a matrix of magnetically permeable wire rods. . . .

A FERRITE PIEZOMAGNETIC STRESS TRANSDUCER
C. E. Land, IRE Internat. Conv. Rec., vol. 9, March 1961, p. 229/243.

PIEZOELECTRIC CONVERTER INVESTIGATION
A. P. Antonuzzi, et al., United States Sonics Corp., Cambridge, Mass., Quarterly rept. no. 1, 1 March - 31 May 1962, 31 May 1962, 20 p., incl. illus. table, 15 refs., AD 277 431.

. . . electroacoustic energy converter . . . will convert with maximum efficiency the energy in an acoustic field on the order of 173 db. The electrical output must be nominally 100 vdc . . .

LOW INPUT VOLTAGE CONVERSION
J. T. Lingle, et al., Minneapolis-Honeywell Regulator Co., Hopkins, Minn., Quarterly progress rept. no. 1, 1 July-30 Sept. 1962, 30 Sept. 1962, 1v., incl. illus., tables, refs., AD 296 305.

. . . literature search . . . Transistor Approach; Tunnel Diode Approach; Electromechanical Approach; Hall Effect Approach; Magnetoresistive Approach; Superconductive Approach; Photoresistive Approach . . . transducer requirements for each approach. . . .

HIGH-FREQUENCY ELECTROSTATIC TRANSDUCERS FOR USE IN GASES
W. M. Wright, Acoustics Research Lab., Harvard U., Cambridge, Mass., Technical memo. no. 47, April 1962, 92 p., incl. illus., tables, 26 refs., AD 276 637.

Electrostatic transducers have been developed which serve as sources and receivers of sound in gases and which are useful, at atmospheric pressure, as frequencies as high as one mc/sec.

DEPART D'ANGLES (Angle Transmission) (In French)
M. Poliet, et al., Ann. Radioelect., vol. 18, no. 72, April 1963, p. 130/152.

. . . the voltages obtained from the aerial synchro units are converted to variable phase signals which are used to modulate sub-carriers in amplitude. . . .

DIGITAL INTEGRATING ACCELEROMETER PROVIDES VELOCITY DATA
W. J. Talon, Space/Aeronautics, vol. 40, Sept. 1963, p. 124/126, A63-23411.

. . . has a series digital output that is particularly useful for providing velocity data when used with a digital computer . . . employs a force balance pendulum as the acceleration sensor . . . can also be used as a self-contained accelerometer . . . by adding a clock generator and a reversible counter to the basic unit.

Related Publications:

A DIGITAL DIFFERENTIAL SHAFT-MOTION ANALYZER
R. L. Lyon, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 829/834.

3A. 333: Thermal Transducers

Included: Thermoelectric devices; Thermal detectors; Temperature detectors; Resistance temperature detectors; Electric temperature measurement; Heat sensing devices; Thin film thermal transducer.

Not Included: Thermo-electric energy converters; Thermophysics; Theory of heat; Thermal design of space craft.

Cross References: Transducers in general (3A. 330); Electromechanical transducers (3A. 332).

Principal Publications:

TEMPERATURE MEASUREMENT
W. M. Rohsenow, et al., IRE Trans. Aeron. Navig. Electronics, vol. ANE-5, no. 1, March 1958, p. 52/57.

TEMPERATURE DETECTORS
C. R. Bingham, Electronics, vol. 32, no. 10, July 1959, p. 55.

DESCRIPTION AND PROPERTIES OF VARIOUS THERMAL DETECTORS
R. DeWaard, et al., Proc. IRE, vol. 47, Sept. 1959, p. 1508/1513.

A TECHNIQUE FOR TEMPERATURE MEASUREMENT IN THE CRYOGENIC REALM
H. P. Gallagher, et al., Proc. Nat. Telem. Conf., May 1960, p. 557/571.

. . . In order to load missile propellant tanking systems to high degrees of accuracy it becomes mandatory that the density of the propellant be known during loading and often time throughout flight.

RESISTANCE TEMPERATURE DETECTORS
V. W. Rose, Instruments and Control Systems, vol. 33, no. 5, May 1960, p. 790/793.

NEW CONCEPTS IN THERMOELECTRIC DEVICE DESIGN
W. H. Clingman, IRE Internat. Conv. Rec., vol. 9, March 1961, p. 174/182.

. . . A thermoelectric system consists, in general, of both a thermal circuit and an electrical circuit . . . Usually there are three parts to the system: two junctions; the thermocouple legs; and the thermal resistances . . .

THIN FILM THERMAL TRANSDUCER
J. G. Gottling, Dig. Intern. Solid State Circuits Conf., no. 5.3, Feb. 1961, p. 58/59.

THERMOELECTRICITY: SCIENCE AND ENGINEERING
R. R. Heikes and R. W. Ure, New York, Interscience Publishers, 1961, 569 p.

EXAMPLES OF THERMOELECTRIC DEVICES (Chapter IV)
A. F. Ioffe, Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 12 Sept. 1962, 32 p., incl. illus., tables, Trans. no. FTD-TT-62-226 from Poluprovodnikovyye Termoelementy, IZDVO AN SSSR, Moscow, p. 126/153, Chapter IV, 1960, AD 286 567.

LIGHT AND HEAT SENSING. SIXTH AGARD AVIONICS PANEL MEETING, PARIS, JULY 1962
H. J. Merrill (editor), Advisory Group for Aeronautical Research and Development, Paris, France, AGARD 71, 1963, 457 p., AD 430 339.

Descriptors: Light, Detection . . . Infrared detectors . . . Ultraviolet radiation . . . Lasers, Fiber optics, Image intensifiers . . .

Related Publications:

THE ELECTRONIC HEAT-CAMERA IN MEDICAL RESEARCH
K. L. Williams, et al., J. Brit. Instn. Radio Engrs., vol. 25, no. 3, March 1963, p. 241/250.

. . . describes early work on determining skin temperatures by detecting and measuring infrared radiation. . . . Pictures built up by scanning techniques are shown . . . design of such equipment. The scanning detector is known as the pyroscan. . . .

3A. 334: Electromagnetic Sensors

Included: X-ray sensors; X-ray spectrometer; X-ray diffractometer; Radiation instrumentation (electromagnetic); Microwave radiometers; Infrared radiometers; Ultraviolet sensors; Photocells; Photo-voltaic cells; Thin film photo-voltaic cells; Field intensity sensors; Millimeter radiometer.

Not Included: Antennas.

Cross References: Radiation instrumentation (particles) (3A. 335); Scientific sensor subsystems (3A. 345); Ultra-violet spectrometer (3A. 345); X-ray television system (3A. 346).

Principal Publications:

AN INTEGRATED AIRBORNE SYSTEM FOR FIELD INTENSITY MEASUREMENTS
S. R. Jones, et al., East Coast Conf. Aeron. Navig. Electronics, vol. 5, Oct. 1958, p. 231/236.

. . . An airborne system that will be used to characterize the radiation fields of ground based transmitters . . . The system, except for antennas, utilizes commercially available components.

A MICROWAVE RADIOMETER EXPERIMENT FOR THE PLANET VENUS
D. E. Jones, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 489/493.

. . . to determine the source of the centimeter radiation, and to scan the planet geographically at several wavelengths to study the surface and atmosphere of the planet, by sending a microwave radiometer to Venus on a space probe. . . .

RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES
C.S. Josias, Proc. IRE, vol. 48, no. 4, April 1960, p. 735/743.

. . . two different GM tubes . . . circuitry . . .

PHOTOVOLTAIC CELLS. PART II. AN ANNOTATED BIBLIOGRAPHY
M.A. Pearcy (comp.), Lockheed Aircraft Corp., Sunnyvale, Calif., Special Bib. no. SB-60-28, Dec. 1960, 39 p., AD 251 572.

RESEARCH AND DEVELOPMENT ON INFRARED DETECTOR
T. E. Hill., GB Electronics Corp., Garden City, N.Y., Rept. TR-89(F) Final rept., Sept. 1961, 66 p., AD 265 166.

. . . combines microwave concepts with infrared sensing elements . . . A photosensitive semiconductor is coincidently energized by a microwave electromagnetic field, and the infrared radiation to be sensed. Since the device employs no dc bias, associated IF noise is eliminated. Further, the sensing element is placed in a high microwave cavity which provides amplification of the order of Q/Pi without deterioration of the S/N.

SPECTRAL RESPONSE OF PHOTOVOLTAIC CELLS
J. J. Loferski, et al., RCA Rev., vol. 22, no. 1, March 1961, p. 38/56.

LARGE-AREA THIN-FILM PHOTOVOLTAIC CELLS
H.I. Moss, RCA Rev., vol. 22, no. 1, March 1961, p. 29/37.

HIGH TEMPERATURE PHOTOELECTRIC TECHNIQUES AND MATERIALS
V. J. Santilli, et al., Westinghouse Electric Corp., Elmira, N.Y., Final technical rept., April 1959 - 31 July 1961, July 1962, 59 p., illus., 15 refs, AD 282 990.

RADIOMETER INSTRUMENTATION FOR THE 1 to 2 MILLIMETER WAVELENGTH REGION
M. Cohn, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 537/541.

. . . a high-sensitivity receiver of special design which is frequently used to detect radiant energy over a relatively broad band.

ULTRAVIOLET INSTRUMENTATION FOR CELESCOPE — AN ASTROPHYSICAL RECONNAISSANCE SATELLITE
R.J. Davis, et al., Applied Optics, vol. 1, March 1962, p. 131/137.

UNIQUE SENSORS STUDY PROGRAM
E. V. Hiatt, Texas Instruments, Inc., Dallas, ASD TDR62 933, 17 Dec. 1962, 1v., AD 405 763.

A program to determine whether a new type of detector could be developed to compete with present-day photon detectors in narrow radiation (approx. 1.0 angstrom) is described. The new detector utilizes the fact the measurable aftereffects occur in a pure gas or mercury vapor when metastable atoms of the gas absorb radiation.

MODERN INFRARED TECHNOLOGY
B. Kemp, Indiana, Howard W. Sams and Co. Inc., 1962, 256 p.

The principles and applications of infrared energy is established and in many new and possible uses are discussed at a level which should prove adaptable to engineers and students alike. . . .

SOME APPLICATIONS OF INFRARED TECHNIQUES IN SPACE FLIGHT AND SPACE RESEARCH
M.R. Nagel, In: Wissenschaftliche Gesellschaft fur Luftfahrt, E.V., Jahrbuch, 1961, Edited by Herman Blenk, Braunschweig, Friedr. Vieweg and Sohn, 1962, p. 339/343, Discussion, p. 343/344, A63-21869.

Presentation of the reasons for the use of IR sensors in the navigational instrumentation of space vehicles. . . . future IR techniques in space navigation is considered.

MULTI-CHANNEL MILLIMETER RADIOMETER FOR DEEP SPACE
E.W. Richter, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 528/536.

BEAM-DEFLECTION AND PHOTODEVICES
K. Schlesinger, et al., Proc. IRE, vol. 50, May 1962, p. 991/1005.

X-RAY DIFFRACTOMETER
JPL Space Progr. Summ., vol. 6, no. 37/15, March/May 1962, p. 47/48.

Will be used for mineralogical analysis of lunar materials. The objectives are to identify the types of minerals of the lunar assemblage, to determine the relative quantities of the mineral types, and to ascertain as far as possible, the precise compositions of the complex minerals. Intended for use on Surveyor . . .

THE COMPARATIVE PERFORMANCE OF ELECTRON TUBE PHOTODETECTORS IN TERRESTRIAL AND SPACE NAVIGATION SYSTEMS
N. P. Laverty, IEEE Trans. Aerospace Navig. Electronics, vol. ANE-10, no. 3, Sept. 1963, p. 194/205.

INFRARED DETECTORS
H. Levinstein, Syracuse U. Research Inst., N.Y, Interim rept., 1 Nov. 1962-31 Jan. 1963, Physics rept. no. 105-1, 1 Feb. 1963, 47 p., illus., 33 refs., AD 296 831.

X-RAY SPECTROMETER
JPL Space Prog. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 94/96.

The objective of the Surveyor X-ray spectrometer experiment is to provide data to determine the elemental composition of materials taken from the lunar surface and subsurface.

Related Publications:

ANTENNAS FOR MICROWAVE RADIOMETRY
H. W. Cooper, East Coast Conf. Aerosp. Navig. Electronics, vol. 6, no. 5.5, Oct. 1959, p. 1/6.

. . . Microwave radiometry is the technique of using the natural radiation of microwave energy by any object at a temperature above zero degrees Kelvin to detect an object or to map the physical features of an area by differences in effective noise temperatures. . . .

INFRARED PHOTOCONDUCTORS
M. L. Schultz, Radio Corp. of America, RCA Labs., Princeton, N.J., David Sarnoff Research Center, Summary Report, Dec. 31, 1963, 62 p., 11 refs., N63-17084.

PHOTOEMISSION AND PHOTOMULTIPLIERS
W.E. Spicer, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1119/1126.

. . . for the practical user of phototubes with emphasis on those parameters of importance in applications such as scintillation counting . . . discussion of photosensitivity, temperature dependence of photoemission, effect of cathode resistivity, response time, effect of initial velocity on transit time disperson and ultraviolet photoemitters.

3A.335: Nuclear Sensors

Included: Particle flux detector; Nuclear radiation detectors; Electrometers; High speed electrometers; Solid state radiation detectors; Neutron detectors; Mass spectrometers; Plasma probes.

Not Included: Radiation counters for prospecting; Scientific instruments for radiation research; Design of nuclear instruments; Theory of radiation detectors.

Cross References: Radiometers for electromagnetic waves (3A.334); Scientific sensor subsystems (3A.345); Solar plasma analyzer (3A.345).

Principal Publications:

PHENOMENOLOGICAL DESCRIPTION OF THE RESPONSE AND DETECTING ABILITY OF RADIATION DETECTORS
R. Jones, Proc. IRE, vol. 47, Sept. 1959, p. 1495/1502.

CURRENT DEVELOPMENTS IN NEUTRON DETECTORS
F. Gardner, Commun. and Electronics, vol. 7, no. 3, March 1960, p. 198/202.

RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES
C.S. Josias, Proc. IRE, vol. 48, April 1960, p. 735/743.

HIGH-SPEED ELECTROMETERS FOR ROCKET AND SATELLITE EXPERIMENTS
J. Praglin, et al., Proc. IRE, vol. 48, no. 4, April 1960, p. 771/779.

THE USE OF PROBING ELECTRODES IN THE STUDY OF THE IONOSPHERE
R. L. F. Boyd, J. Brit. Instn. Radio Engrs., vol. 22, no. 5, Nov. 1961, p. 405/408.

The Langmuir probe and its developments provide a means whereby such important ionospheric quantities as electron concentration and temperature, and ion mass spectrum, concentration and temperature may be measured. . . . The problems involved arise largely because the vehicle is isolated from Earth and because of the varying aspect of the vehicle. . . . involves the use of special techniques which are not needed in the laboratory. The ways in which the problems have been tackled will be discussed and special reference will be made to the instrumentation planned for the first Anglo-U.S. satellite. . . .

PLASMA PROBES ON SPACE VEHICLES
R. L. F. Boyd, In: Ionization Phenomena in Gases, vol. II., Amsterdam, Netherlands, North-Holland Publishing Co., 1962, p. 1387/1396, 11 refs., A63-21936.

Review of the use of Langmuir probe techniques on space vehicles to obtain data on ions in the upper atmosphere. . . . experiment aboard the Explorer VIII . . . which carried singly-and doubly-gridded plane probes.

NUCLEAR RADIATION DETECTORS
G.A. Morton, Proc. IRE, vol. 50, May 1962, p. 1266/1275.

MARINER R — PARTICLE FLUX DETECTOR
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 16/18.

The ionization chamber . . . measures the total ionization rate per unit volume of gas produced by radiation able to reach the sensitive part of the instrument. . . . It is, therefore, useful to measure this flux with an instrument so matched to the ionization chamber that the two instruments respond to particles of the same energies.
The simplest device which can measure the required flux is a Geiger-Muller (GM) tube . . .

FIELDS AND PARTICLES EXPERIMENT FOR RANGERS 7, 8, 9
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 53/61.

Ionization Chamber . . . Particle Flux Detector . . . Dust Particle Experiment . . . Search Coil Magnetometer . . . Low Energy Ion Detector. . . . Electron Flux Detector . . . Electron-Proton Spectrometer . . . Low Energy Solar Protons.

PLASMA PROBE
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 81/83.

A development program has been initiated to perfect an advanced design plasma probe (Fig. X7) for use on the advanced Mariner spacecraft. . . . utilization of techniques achieved in the development of the Surveyor plasma probe will afford higher resolution measurements of a broader particle energy spectrum than obtainable with the Ranger instrument.

PARTICLE FLUX DETECTOR
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 79/81.

The ionization chamber, which has already been developed for a radiation monitor (Ref. 1), measures the total ionization rate per unit volume of gas produced by radiation able to . . . The simplest device which can measure the required flux is a Geiger-Mueller (GM) tube with a wall the same as the ionization chambers. . . . A GM tube particle flux detector has been developed for use with the ionization chamber on the Mariner Venus (1962) spacecraft. Figure 6 shows the complete package . . .

THE SPACECRAFT RADIATION EXPERIMENTS
W. L. Brown, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 899/941.

. . . on the Telstar spacecraft . . . designed to measure the electron and proton particle distributions in the region of space explored by the satellite orbit and to give information on the integral semi-conductor radiation damage produced by these particles . . .

SATELLITE INSTRUMENTS USING SOLID STATE DETECTORS
R.W. Fillius, Iowa State U., Iowa City, Aug. 1963, 131 p., refs., N64-19983.

RADIO-FREQUENCY MASS SPECTROMETERS AND THEIR APPLICATIONS IN SPACE
A.S. Gilmour, Jr., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1404/1410.

BIBLIOGRAPHY ON MASS SPECTROMETRY
In: Advances in Mass Spectrometry, vol. II, Oxford, England, Pergamon Press Ltd., 1963, p. 561/610, A63-17282.

. . . over 1000 references, compiled from some 550 journals . . . from January 1958 to December 1960.

3A.338: Other Sensors

Included: Lunar seismographs; Magnetometers; Fluxgate magnetometer; Toroidal core magnetometer; Magnetic spectrometer; Rubidium magnetometer; PPM type magnetometer.

Not Included: Theory of earth magnetism.

Principal Publications:

LUNAR SEISMIC EXPERIMENT
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 1/9.

Telemetered data of the seismic activity on the Moon could serve as an index of the thermal regimen of the Moon's interior. . . . An early lunar seismic experiment, where weight limitation is severe and impact velocity may be high, will require a rugged short-period seismometer. . . Analysis of Lunar Seismograms. . . Meteorite impacts as seismic sources. . .

MAGNETORESISTIVE MAGNETIC-FIELD SENSOR
M. Epstein, et al., Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 611.

METASTABLE HELIUM SENSITIVE MAGNETOMETER
J. A. Rice, Jr., IRE Internat. Conv. Rec., vol. 9, March 1961, p. 244/248.

A PULSE-POSITION MODULATOR-TYPE MAGNETOMETER
S. Stricker, et al., Commun. and Electronics, vol. 80, no. 55, July 1961, p. 253/258.

EXPLORER X
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April, 1961, p. 70/71.

. . . carried a rubidium magnetometer similar to the one to be carried by the Ranger spacecraft and had as its prime function the measurement of the earth's magnetic field intensity.

MARINER A
JPL Space Progr. Comm., vol. 1, no. 37-9, March/April 1961, p. 34/35.

BRIEF DESCRIPTION OF RANGER LUNAR SEISMOGRAPH
F. E. Lehner, Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2297.

RESULTS OF LOW FIELD STUDIES USING TOROIDAL CORE MAGNETOMETER
JPL Space Progr. Summ., vol. 6, no. 37-18, July/Nov. 1962, p. 74/75.

Because the core consists of a closed magnetic path, the operation of this magnetometer differs from an ordinary flux-gate magnetometer. . . in that the two cores of the flux-gate saturate independently, while the toroidal core saturates uniformly.

COMMUTATED FLUXGATE MAGNETOMETER
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 96/97.

Section 3A.34
Input Subsystems

3A.340: Data Acquisition Systems

Included: Remote sensing systems.

Not Included: Signal conditioning subsystems for space links.

Cross References: Flight instrumentation in general (3A.330).

Principal Publications:

A HIGH-SPEED, AIRBORNE DIGITAL DATA ACQUISITION SYSTEM
S. Cogan, et al., IRE Trans. Space Electronics Telemetry, vol. SET-5, no. 3, Sept. 1959, p. 117/122.

. . . PCM/FM data acquisition system. . . . part of a larger system designed to provide an accurate and reliable means of collecting information from a large number of transducers during aircraft flight testing, and to transfer this information in the most efficient manner to a digital computer for final data reduction.

SOME NEW TECHNIQUES IN AIRBORNE DATA ACQUISITION
M. E. Harrison, et al., Nat. Symp. Space Electronics Telem., no. 5.2, Sept. 1959, p. 1/14.

AN ANALOG AND DIGITAL AIRBORNE DATA ACQUISITION SYSTEM
D. H. Ellis, et al., Proc. IRE, vol. 48, no. 4, April 1960, p. 713/724.

STUDY AND EXPERIMENTAL RESEARCH INTO FLIGHT INSTRUMENTATION FOR VEHICLE OPERATION IN THE FRINGE OR OUTSIDE OF THE ATMOSPHERE. VOLUME I. SUMMARIES OF THE ANALYSES OF SENSING TECHNIQUES
S. C. Stephan, Jr., Bell Aerosystems Co., Buffalo, N. Y., Rept. no. 60003-077, vol. 1, ASD TR 61-142, vol. 1, Nov. 1961, 134 p., AD 271 602.

. . . The type of techniques investigated include: environmental sensing, optical and infrared radiation, radio and radar transmitting and receiving, and inertial systems.

STUDY AND EXPERIMENTAL RESEARCH INTO FLIGHT INSTRUMENTATION FOR VEHICLE OPERATION IN THE FRINGE OR OUTSIDE OF THE ATMOSPHERE. VOLUME II. DETAILED ANALYSES OF SENSING TECHNIQUES
S. C. Stephan, Jr., Bell Aerosystems Co., Buffalo, N. Y., Rept. no. 60003-077, vol. 2, ASD TR 61-142, vol. 2, Nov. 1961, 250 p., AD 271 601.

. . . promising sensing techniques to provide the data for the control of vehicles operating in the fringe or outside of the earth's atmosphere. . . . Direct Measurement of Environmental Properties, Radio and Radar Sensing, Inertial Sensing, Optical and Infrared Sensing. . . . Wherever appropriate, numerical evaluation of the probable performance errors of the sensing techniques has been made.

DATA ACQUISITION SYSTEMS FOR CONTROL APPLICATIONS
K. L. Smith, J. Brit. Instn. Radio Engrs., vol. 24, no. 6, Dec. 1962, p. 497/506.

. . . The advantages of modularity are stressed with particular reference to the interface concept. . . . data gathering systems can be classified under two main headings:
(a) Data collection systems
(b) Data acquisition systems
. . . Data acquisition systems are normally associated with process control applications.

BIBLIOGRAPHY OF REPORTS ON DATA ACQUISITION INSTRUMENTATION
Inter-Range Instrumentation Group, White Sands Missile Range, N. Mexico, Document no. 101-62, May 1962, 80 p., AD 275 277.

A METHOD OF DATA ACQUISITION AND SYSTEM CONTROL THROUGH TIME SHARING OF MIXED INPUTS
B. Brentnall, Stanford U., Calif., Feb. 1963, 33 p., AD 417 186.

INFORMATION SOURCES FOR A MANNED SPACE COMMAND AND CONTROL STATION
F. A. Muckler, et al., Conf. Proc. Nat. Winter Conv. Mil. Electronics, vol. 2, Feb. 1963, p. 18/24, 14 refs.

. . . For two classes of data—object discrimination and meteorological observations - five conventional data collection techniques are examined: (1) direct vision, (2) main-periscopic magnification, (3) photography, (4) infrared, and (5) radar. Accurate data for object discrimination presents a severe technical challenge with any single sensor or combination of sensors.

Remote sensing is intended to include all possibilities for acquiring information without the necessity of close contact with the source of information; hence gravimetric, seismic, acoustic, and other force sensing techniques, as well as those involving electromagnetic propagation, are appropriately included. . . . rapid acquisition of data from. . . spaceborne platforms. . . The term environment is intended to apply to atmospheric and extraterrestrial applications as well as to studies of the earth's surface.

PROCEEDINGS OF THE SECOND SYMPOSIUM ON REMOTE SENSING OF ENVIRONMENT 15, 16, 17 OCTOBER 1962
Institute of Science and Tech., U. of Michigan, Ann Arbor, Rept. no. 4864-3-X, Feb. 1963, 459 p., incl. illus., tables, refs., AD 299 841.

3A.342: Character Readers

Included: Optical reading machines; Character recognition equipment; Automatic character recognition units; Handwritten character recognizers.

Not Included: Pattern recognition methods (2).

Cross References: Reading equipment for the blind (3A.349).

Principal Publications:

OPTIMIZATION OF REFERENCE SIGNALS FOR CHARACTER RECOGNITION SYSTEMS
I. Flores, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 54/61.

The role of signal structure in a signal discrimination system is discussed. The optimality criterion for reference signals for detection in the case of white Gaussian independent noise is defined. The need for normalization of the reference signals is demonstrated. A geometric interpretation is presented. Optimum classes are obtained and several examples cited. . . . to find means for placing information on the documents in the form of printed characters which can be identified unambiguously by humans and yet can be read easily by machine means.

READING PRINTED DATA ELECTRONICALLY
N. E. Golovin, Automation, vol. 8, Dec. 1961, p. 60/64.

A matrix comparison method of character recognition is described. The documents are fed one at a time under an optical head which projects the character images onto a photocell bank. The resulting signals are amplified and quantized before being passed to a shift register storage matrix. . . . Recognition circuits select the matrix providing the highest output voltage. . .

THE SIMULATION OF THREE MACHINES WHICH READ ROWS OF HANDWRITTEN ARABIC NUMBERS
L. A. Kamentsky, IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 489/501.

. . . Each of these simulated machines has read documents containing rows of handwritten Arabic numbers. Sample numbers were produced by at least 20 people for each simulation study. . . .

SOME COMMENTS ON CHARACTER RECOGNITION
E. A. Newman, Computer J., vol. 4, July 1961, p. 114/120.

OPTICAL CHARACTER READERS USE MEMORY DRUMS, MATRICES TO INCREASE VERSATILITY
W. E. Bushor, Electronics, vol. 35, Feb. 1962, p. 26/27.

An optical reading machine, containing a memory, which can be instructed to edit and rearrange data is described.

WHEN CAN YOU JUSTIFY OPTICAL CHARACTER READERS
T. W. Helweg, Control Engng., vol. 9, Feb. 1962, p. 119/121.

Comments on the characteristics of optical scanners and their operating problems are given. Centralized operations such as public utilities and insurance companies derive the maximum benefit from optical scanners due to the large volume of documents handled and the ability to provide highly standardized forms. Decentralized operations encounter problems in document control. . .

READING DEVICES
B. M. Avrukh, et al., Joint Publications Research Service, Washington, D. C., JPRS: 18119, Collection of papers presented at the Conference on Processing Information, Machine Translation, and Automatic Reading of Text Matter, Moscow, Jan. 1961; Foreign Developments in Machine Translation and Information Processing no. 113, 13 March 1963, 434 p., 123 refs., AD 401 612.

Basic methods for automatic reading and recognition of text matter. . . the use of the contours of symbols in automatic character recognition. . .

AUTOMATIC READING MACHINE FOR TELEGRAPH SERVICE
W. D. Buckingham, Proc. Spring Joint Comp. Conf., May 1963, p. 113/116.

. . . an optical character reader suitable as a terminal device for data communications over a telegraph line. A document is automatically wrapped around a drum, and the character to be recognized is focused upon an 8 x 11 array of photocells. Recognition is by a simple form of pattern matching, and alignment is accomplished by horizontal and vertical arrays of other photocells. Maximum reading rate is 16.2 characters per second.

AN EXPERIMENTAL RESULT ON CHARACTER RECOGNITION (Correspondence)
C. K. Chow, IEEE Trans. Electronic Comp., vol. EC-12, no. 1, Feb. 1963, p. 25.

UNIVERSAL PRINT READER
A. K. Dietrich, et al., General Precision Lab., Inc., Pleasantville, N. Y., Final rept., RADC TDR63 181, March 1963, 1 v, AD 404 846.

. . . to determine the potential capabilities of the Link Reading Technique toward fulfilling the requirements of a reading machine which could be appropriately referred to as "A Universal Print Reader." . . . contains a detailed description of the operating principles of a complete page reading system . . .

CYCLOPS-1: A SECOND-GENERATION RECOGNITION SYSTEM
T. Marill, et al., In its Studies in Autom. Pattern Recognition, 31 Oct. 1963, p. 1/15, refs., Presented at AFIPS Fall Joint Computer Conf., Las Vegas, 12 Nov. 1963, Submitted for Publication, N64-19420.

. . . is a working recognition system with the following capabilities: (1) . . . can recognize all landprinted alphabetic and numeric characters . . . (2) . . . can analyze complex visual inputs . . . the characters may be of different sizes and orientations; they may overlap, or be inside of one another; they may be superimposed on arbitrary backgrounds consisting of meaningless lines or spots or geometric shapes . . .

A NEW METHOD FOR AUTOMATIC CHARACTER RECOGNITION
P. G. Perotto, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 521/526.

. . . applied to the construction of a very high performance reading machine.

Related Publications:

CHARACTER RECOGNITION BY DIGITAL COMPUTER USING A SPECIAL FLYING SPOT SCANNER
R. L. Grimsdale, et al., Computer J., vol. 4, July 1961, p. 129/136.

A device which recognizes spatial patterns is discussed. . . . works even if the scanned character is translated horizontally or vertically, and if small rotations are performed.

CHARACTER QUALITY AND SCANNER ORGANIZATION
I. W. Merry, et al., Computer J., vol. 4, July 1961, p. 137/144.

The quality of recognition in scanning systems which employ a mapping on a binary matrix is discussed. The effect of certain parameters such as spot size and illumination intensity, raster line pitch and linearity, light diffusion and reflection, and video output linearity, on the reliability of a scanning system is considered.

3A.343: Navigational Input Subsystems

Included: Space rendezvous terminal sensors; Terminal guidance sensor subsystems; Rendezvous interferometer; Stelatrac radar subsystem; Guidance sensors; Star-lock system; Star seekers; Horizon sensors; Altitude reporting subsystems; Attitude determination subsystems; Ranging subsystems as input systems for data processing.

Not Included: Design of ranging systems; Design and operation of radar systems; Rendezvous procedures.

Cross References: Space-borne computers (Div. 3A.8).

Principal Publications:

ALTITUDE SENSING FOR AUTOMATIC ALTITUDE REPORTING
J. Andresen, IRE Trans. Aerospace Navig. Electronics, vol. ANE-8, no. 4, Dec. 1961, p. 153/156.

A short resume is given of the means used to measure altitude for reporting purposes, possible sources of error, followed by a description of three of the most commonly used analog-digital converters. . . .

SPACE RENDEZVOUS TERMINAL SENSORS
W.H. Heiss, et al., Proc. Nat. Aerosp. Electronics Conf., vol. 9, May 1961, p. 64/75.

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Jan. 1961, p. 47/50.

Stored-Program Controller.
The principal function of the arithmetic unit (A/U) of the stored-program controller (SPC) is to perform arithmetic operations on numbers. The present unit can add, subtract, compare, and store numbers. Later, the necessary controls will be added to provide for shifting, multiplication, and division. . . . Another closely-related family of operations are the bit-wise or logical operations which operate on individual bits of a word independently of operations performed on other bits. The third function of the A/U is to provide information to assist the control unit (CU) in directing the flow of the program.

STELATRAC, A MODULAR SPACEBORNE TERMINAL GUIDANCE RADAR
G.R. Heidbreder, Rec. Nat. Symp. Space Electronics Telemetry, no. 5.2, Oct. 1962.

. . . a single basic radar configuration is employed with the varying radar requirements accommodated by the addition or interchange of modules. . . . STELATRAC is an all solid-state, x-band coherent radar designed specifically to meet . . . reliability requirement. A laboratory model. . . in the context of a beacon-tracking rendezvous and docking mission, has been built and tested. . . .

FM STAR-LOCK SYSTEM USING MASK WITH LINEAR SECTORS
E.K. Sandeman, IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 1, March 1962, p. 24/34.

. . . a suitable rotating element in the optical system causes the image of the star field to mutate over the surface of a mask divided into alternative sectors of opaque and transparent material. When the lock star is on the axis of the entry optical system, the lock-star image traverses a circular path on the mask concentric with the mask giving rise to an unvarying frequency in the output of a photo cell behind the mask. With misalignment . . . the output of the photocell is frequency modulated. The resulting FM wave is suitably processed to provide misalignment signals along two axes. . . .

FM STAR-LOCK SYSTEM USING MASK WITH SPIRAL SECTORS
E.K. Sandeman, IRE Trans. Aerosp. Navig. Electronics, vol. ANE-9, no. 1, March 1962, p. 35/47.

TORQUE MODULATION AND MODULATION ERROR DETECTION CONCEPTS IN MODERN INSTRUMENTS
H. Schlitt, In NASA, Marshall Space Flight Center, Huntsville, Ala., From Peenemunde to Outer Space (A Volume of Papers) Commemorating the Fiftieth Birthday of Wernher Von Braun, March 23, 1962, p. 561/572, N63-16001.

RENDEZVOUS INTERFEROMETER FOR GEMINI RADAR
M.S. Wheeler, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 5.3, Oct. 1962.

A simple, accurate interferometer antenna has been designed to solve the space rendezvous problem of initial acquisition, final approach and docking of two space vehicles. A set of three Archimedean spiral antennas, operating upon a circularly polarized plane wave, measures the direction cosine to the target over 50^o of space by a simple rotation of two of the spirals. . . .

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ONBOARD PROCESSING
J.S. Albus, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., July 1963, 22 p., refs., N64-10091.

. . . description of the digital solar aspect sensor and a discussion of the onboard data processing systems . . .

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING
J.S. Albus, et al., IEEE Trans. Space Electronics Telemetry, vol. SET-9, no. 3, Sept. 1963, p. 71/77.

. . . orientation of spin stabilized satellites . . . Aspect information is collected optically from the sun, moon and earth. . . . Some interesting results of asepct measurements on Explorer XII showed an unexpected increase in spin rate due to solar pressure, and on Explorer XIV an erratic precession history. . . .

NIMBUS ATTITUDE DETERMINATION SUBSYSTEM
R. Bartlett, et al., Allied Research Associates, Inc., Concord, Mass., Final rept., Rept. no. ARA 9207 03 1, 7 June 1963, 90 p., AD 420 987.

. . . by photogrammetric techniques . . . Coordinate measurements of landmarks and common points in adjacent triplets appearing in kinescope generated cloud cover photographs are measured on a film reader whose output feeds a digital computer for immediate computation of attitude. . . . required for accurate referencing of Nimbus satellite data. . . .

FINE GUIDANCE SENSOR FOR HIGH-PRECISION CONTROL OF THE OAO
N.A. Gundersen, American Institute of Aeronautica and Astronautics, Summer Meeting, Los Angeles, Calif., June 17-20, 1963, Paper 63-211, J. Spacecraft and Rockets, vol. 1, Jan.-Feb. 1964, p. 91/95, 7 refs., A64-14331.

A NEW GENERATION SPACEBORNE GUIDANCE SENSOR STELATRAC
J.E. Holland, American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Cambridge, Mass., Aug. 12-14, 1963, Paper 63-349, 13 p., A63-20670.

Description of a new means for stabilizing phase-lock receivers, called the injected reference technique, and of its incorporation into STELATRAC (Space Technology Laboratories Tracking and Command), a modular all solid-state X-band guidance sensor. The rendezvous and docking, and lunar landing sensors, are briefly summarized.

A SYSTEMS APPROACH TO STAR TRACKERS
F.V. McCanless, IEEE Trans. Aerospace Navig. Electronics, vol. ANE-10, no. 3, Sept. 1963, p. 182/193, 31 refs.

. . . signal processing analysis is based on the similarity between communication system theory and the several types of star trackers. . . . primarily concerned with the internal parameters of star tracker design . . . Equations describing the modulation process are developed and compared to communication practices. . . .

STUDY OF MULTI-FUNCTION SENSORS FOR GUIDANCE SUBSYSTEMS
A.A. Miccioli, Wright Patterson AFB, Ohio, AF Avionics Lab., Final Report, 1 July 1962-30 June 1963, RTD-TDR-63-4049, Dec. 1963, 82 p., refs., AD 425 224, N64-13127.

Experimental and analytical investigations of the extension of the GPL area correlation technique from terrain matching to simultaneous star field and beacon tracking in the context of a space rendezvous mission . . . It was indicated that the extension was a feasible one . . .

BACKGROUND AND REQUIREMENTS ON RADAR SENSORS FOR SPACECRAFT
R.J. Taylor, et al., American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Cambridge, Mass., Aug. 12-14, 1963, Paper 63-348, 28 p., A63-21693.

. . . results of a phase-I survey and problem-definition study . . . utility of both Earth-based and spaceborne RF sensors in various segments of a lunar mission. Typical characteristics of such radar are discussed. . . .

Related Publications:

A CRITIQUE OF RADAR IN SPACE
R.D. Taylor, Rec. Nat. Symp. Space Electronics Telemetry, no. 5.1, Oct. 1962.

The mission requirements for space rendezvous, both cooperative and non-cooperative, are translated into sensor requirements. . . . Conventional pulsed radar systems are selected as being, in general, the sensors best suited to the tasks.

. . . Consideration is given to the all-visual approach, and the advent of improved IR and optical LASER systems is discussed in view of the advancing state of the art. . . .

3A.345: Scientific Sensor Subsystems

Included: Computer controlled diffractometer; Solar plasma analyzer; Plasma diagnostics; Mars microscope; Petrographic microscope; Ultraviolet spectrometer; Complete satellite sensor subsystems; Planetary scan system; Instrumentation subsystems for lunar surface exploration; Soil mechanics experiment; Mars biological experiments; Gas chromatograph; Bio-instrumentation system; Re-entry research instrumentation.

Not Included: Theory of space experiments; Astrophysics and geophysics; Signal conditioning subsystems; Physiological science.

Cross References: Plasma probes (3A.335); Ultraviolet sensors (3A.334).

Principal Publications:

INSTRUMENTING THE EXPLORER I SATELLITE
H. L. Richter, et al., Electronics, vol. 32, Feb. 1959, p. 39/44.

INSTRUMENTATION OF NERVOUS SYSTEM FOR STUDIES OF BEHAVIOR AND PERFORMANCE IN SPACE FLIGHT
W. R. Adey, IRE Nat. Symp. Space, no. 6-2, Sept. 1960, p. 1/13.

REQUIREMENTS FOR MONITORING PHYSIOLOGICAL FUNCTION IN SPACE FLIGHT
L. D. Carlson, IRE Nat. Symp. Space, no. 6-1, Sept. 1960, p. 1/11.

BIO-INSTRUMENTATION FOR SPACE FLIGHT
G. W. Gleason, Proc. Nat. Telem. Conf., May 1960, p. 57/62.

MARS MICROSCOPE
G. A. Soffen, JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 1/3.

The present laboratory effort is directed toward examining these problem areas: (1) acquisition, treatment, and handling of the sample; (2) selection of the optical-vidicon systems; and (3) objective methods of data discrimination and interpretation.

MARINER R-SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 25/27.

The Mariner R solar plasma experiment has been designed to measure positive ions in 10 energy levels. The measurement is accomplished by impressing programmed voltages across curved electrostatic deflection plates. The geometry of the plates and voltage across them determines the energy level of the entering particles that reach the collector cup.

DATA PROCESSING FOR THE GODDARD EXPERIMENT
D. S. Kushner, Rec. Nat. Symp. Space Electronics Telemetry, no. 4.4, Oct. 1962.

. . . designed to measure the ultraviolet radiation from stars over a range of spectral wavelengths. The Data Processing Subsystem of the experiment accumulates and processes the experimental data and controls the performance of the experiment.

Six parallel data channels accumulate pulses that represent the intensity of radiation at six different incremental portions of the ultraviolet spectrum. . . . sequentially sampling . . . automatically . . . Data accumulated . . . stored in spacecraft memory. Compression techniques are employed to reduce the number of bits that must be stored. . . .

OBSERVING THE ATMOSPHERE—A CHALLENGE
V. E. Suomi, Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2192/2197.

GEOPHYSICAL PARAMETERS INSTRUMENTATION
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 39/45.

A group of instruments designed to measure simple physical properties both on and beneath the lunar surface from a Surveyor soft-landing spacecraft and thereby termed, "geophysical parameters instrumentation." The subsurface instruments have been incorporated into a logging sonde, whereas the surface instruments are deployed separately on the surface from the spacecraft by means of booms or arms. The present summary briefly describes both the methods of measurement and the surface and subsurface prototype instrumentation.

MARINER 2 SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 95/96.

. . . has completed 112 days of in-flight operation in Mode II, the spacecraft cruise mode, and 7 hr in Mode III, the encounter mode . . . Its performance has been a source of great satisfaction to the people involved in the project. Two anomalies, however, have been noted and are currently being investigated.
. . . an unexplained downward shift in the electrometer current calibration. . . .

PETROGRAPHIC MICROSCOPE
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 48/50.

Will be used on Surveyor for remote observation of crushed rock samples in transmitted light . . . A sample consisting of particles in the size range 75 to 300 μ is delivered to the microscope by the spacecraft and is deposited in the centrifugal hopper. The hopper and its contents are then heated: when the particles reach a temperature of 270 to 280° F, the hopper spins and the particles are thrown against a thermoplastic tape. . . . The tape is threaded through a sprocket mechanism which is driven by a rotary solenoid . . . The objective lens is initially focused on a plane below the plane containing the tops of the particles. The zone of focus of the lens moves in seven discrete 40-μ steps through the image plane of the particles to . . . A visual image is taken at each step of the focusing sequence.

PLANETARY SCAN SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-18, July/Nov. 1962, p. 70/72.

A planetary scan system has been developed which is capable of performing three major operations on board a spacecraft: planet searching, planet acquisition, and planet scanning. A block diagram of the system is shown . . .

PLASMA INSTRUMENT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 69/71.

Operation of the advanced design Mariner plasma instrument is sequenced by a programmer presently being developed to satisfy the more complex requirements of the new instrument. Although improved in several respects, the basic circuitry of the new programmer remains similar to that found in earlier JPL plasma instruments.

SCIENTIFIC SYSTEM FOR THE ADVANCED MARINER
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 34/41.

. . . composed of diverse instruments . . . Table 1 lists the instruments chosen to be flown at some time during the project. The scientific instruments can be divided into three groups according to their location on the spacecraft: (1) the bus (main spacecraft structure), (2) the capsule, or (3) the planetary horizontal platform.

SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 75/76.

During March and April, four plasma analyzers for the Mariner Venus (1962) mission were completed and integrated into the spacecraft system. . . . an operating history was being accumulated on each of the analyzers.

ULTRAVIOLET SPECTROMETER
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 66/69.

For the Mariner Venus (1965) mission . . . the instrument can look at the day side of the planet Venus, and detect ultraviolet auroma and dry glow. The telescope will no longer be required to look at the night side while rejecting day side radiation from a source several degrees off axis . . . Test Results of Model 9-15 UV Spectrometer. . . .

GAS CHROMATOGRAPH INSTRUMENTATION DEVELOPMENT
L. Bowman, et al., JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 169/176.

. . . for analysis of planetary atmospheric composition and biological organics. The principal subjects discussed here are as follows: (1) laboratory chromatograph, (2) calibration of cross-section detector, (3) linear-logarithmic electrometer, (4) linear automatic scale changing electrometer, and (5) automatic baseline compensation.

COMPUTER-CONTROLLED DIFFRACTOMETER
H. Cole, et al., Rev. Sci. Instrum., vol. 34, Aug. 1963, p. 872/876, 11 refs., A63-21503.

. . . general features of a computer-controlled X-ray diffractometer system. A standard four-axis Geiger-counter single-crystal diffraction configuration is made automatic by attaching encoders to all shafts, with provision made for electronic input of all settings and readout of all data. A small solid-state computer is made an integral part of the system, which permits the system to be used in a decision-making closed-loop manner. . . .

MICROMINIATURIZED INSTRUMENTATION PACKAGE
A. B. Ellis, et al., Hughes Aircraft Co., Culver City, Calif., Final rept. on Phase 3, Feb. 1963, 64 p., incl illus., tables, 184 refs., AD 296 877.

. . . measurements . . . human physiological condition. . . . sensors and transducers . . . construction of prototype hardware . . . three useful microminiaturized instrumentation packages.

SAMPLE COLLECTION FOR MARS BIOLOGICAL EXPERIMENTS
N. Eskind, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 275/278.

. . . detection and identification of biological material. Proper functioning of biological life detection systems on early probes is especially important since the possibility of the Martian ecology being disturbed by landing vehicles is always present.

FLIGHT INSTRUMENTATION FOR REENTRY PLASMA SHEATH
A. E. Fuhs, Aerospace Corp., Los Angeles, Calif., 12 July 1963, 37 p., Rept. no. TDR169 3153 20TN1, AD 422 293.

. . . The instruments respond to the induced magnetic field produced by the interaction of the ionized gas flowing through an applied magnetic field. . . .

A TRANSISTORIZED DIGITAL COMPUTER WITH BOTH REAL AND STORED TIME ANALOG READOUT OF INFORMATION—FOR USE IN DEEP SPACE INVESTIGATIONS OF MICROMETEOR PHENOMENA
D. C. Mueler, Oklahoma State Univ., Research Foundation, Stillwater, Final rept., Dec. 1963, 96 p., AD 435 692.

. . . Report on Design, Development and Construction of Micrometeorite Detection Systems. . . . A system was designed and developed, and 24 units produced. Each unit is essentially an electronic system designed for the express purpose of exploiting the data-gathering potential of a specific space vehicle. . . .

PLASMA DIAGNOSTICS
C. E. Wharton, Northwestern University, and American Institute of Aeronautics and Astronautics, Biennial Gas Dynamics Symposium, 5th Physico-Chemical Diagnostics of Plasmas, Evanston, Ill., Aug. 14-16, 1963, Paper 63-367, 40 p., 23 refs., A63-24324.

Brief survey of several plasma diagnostic techniques . . . Certain of the methods that have been extensively developed or have considerable potential are then discussed in more detail, covering microwave diagnostics, optical and IR probing, conductivity, Langmuir and magnetic probes, optical spectroscopy, and fast photography.

SOIL MECHANICS EXPERIMENT
JPL Space Prog. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 80/82.

Designed to make quantitative measurements related to the load bearing strength and shear strength of the lunar surface immediately adjacent to the Surveyor spacecraft . . . Other soil properties such as structure, composition, and particle size may possibly be deduced by interpretation of the measured parameters.

MARINER C SCIENTIFIC INSTRUMENTATION—SCIENCE SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 71/77.

. . . is composed of instruments and ancillaries selected to meet the mission objectives namely, to make planetary observations and perform field and particle measurements in interplanetary space during the trip and in the vicinity of Mars. The instruments and their ancillaries designed to accomplish these purposes are listed and briefly described in Table 2 and Fig. 12.

Related Publications:

AN AUTOMATIC SCALE FACTOR DEVICE FOR USE WITH SPACECRAFT ELECTROMETERS

J. H. Marshall, JPL Space Progr. Summ., vol 4, no. 37-23, Aug./Sept. 1963, p. 245/254.

. . . for example, the plasma probe on Mariner 2 used an electrometer for measuring currents between 10^{-13} and 10^{-6} amp. Also, future experiments involving gas chromatography and mass spectrometry will probably require similar electrometers. . . . some form of logarithmic scale compression must be used. On the Mariner 2 plasma probe of vacuum diode operating in the retarded field region provided a logarithmic transfer impedance. This compression scheme had the disadvantages of slow response because of large (5 pf) interelectrode capacity, relatively large instabilities resulting from dependence on tube characteristics, and the unreliability inherent in hot filament vacuum tubes. . . . describes an improved version of the automatic scale factor device . . .

3A.346: Picture Generating Subsystems

Included: X-ray television system; Vidicon camera subsystem; Lunar TV camera subsystem; Astronomical space telescopes; TV telescope; Balloon telescope subsystem.

Not Included: Television technology; Vidicon development.

Cross References: X-ray sensors (3A.334).

Principal Publications:

LUNAR TV CAMERA MANIPULATOR, (Final Report)
F. Grimm, et al., General Mills, Inc., Minneapolis, Minn., Electronics Group, 1960, 166 p., 13 refs., N63-21118.

RANGER—TELESCOPE VIDICON CAMERA
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 20/24.

It can be demonstrated that, with a 40-inch equivalent focal length telescope which is perhaps the maximum for the Ranger payload, photographs secured with a 200 TV line scan vidicon at 4000 km distance will just about equal the best resolution secured from earth based telescopes. Therefore, there is little purpose in attempting recordings at a greater distance from the moon. The present vidicon telescope system will transmit from 4000-km down to 24-km altitude . . . a. Vidicon system b. Vidicon sensor c. Optical telescope.

NEW TV CAMERA DESIGNED FOR ROUGH USAGE (Solid-State Circuitry Employed Throughout)
W. S. Ivans, Jr., Milliles Space, vol. 8, March 1962, p. 24/25+

. . . primarily for industrial and military closed-circuit TV systems. It's already used on the Martin Company's Titan, General Dynamics-Astronautics' Atlas, and the Boeing Company's Minuteman programs.

A LARGE DIAMETER X-RAY SENSITIVE CAMERA TUBE
R. Rutherford, Jr., CBS Labs., Stamford, Conn., Final rept., 1 Oct. 1962, 22 p., incl. illus., AD 295 502.

. . . of the photoconductive selenium surface type . . .

AN X-RAY TELEVISION SYSTEM WITH IMAGE STORAGE AND AUTOMATIC EXPOSURE-RELEASE
A. J. Seyler, J. Brit. Instn. Radio Engrs., vol. 24, no. 3, Sept. 1962, p. 229/240.

. . . containing an electronic recording storage tube . . . The sequence of storage tube functions and x-ray exposure is automatically controlled by a central timing device and all time intervals are synchronized with the vertical scanning period of the television systems. By actuating a single exposure release button when a new image is required, erasure of the previous image and storage of the new one are completed within half a second. . . . The unit is presently undergoing tests for quantitative evaluation of its performance and for the investigation of its medical potential. . . .

MARINER MARS 1964 LOGICALLY CONTROLLED SHUTTER-AND-FILTER WHEEL
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 81/82.

As presently conceived, the Mariner television experiment requires that pictures be taken with alternate color filters once every 40 sec at an exposure time of the order of 0.1 sec. In the interests of mechanical simplicity, reliability, and compactness, the color wheel and shutter have been combined into one rotating device actuated by a single electrical solenoid.

MARINER B—TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 35/38.

Two views of Mars as observed from Mariner B for a 1964 planned trajectory approaching to 13,000 km are shown in Fig. 1.
Vidicon transfer characteristics.
Hardware—Present plans.

OAO IMAGE CONVERTER RESEARCH
J. Burns, Chicago U., Ill. Labs for Applied Sciences, LAS-TR-226-3, Final Report, 1963, 38 p., refs., N64-14840.

Performance requirements are defined for image converters that are used in conjunction with advanced generations of oribiting astronomical telescopes . . . include use of the image converter in various classes of observations that can be performed to advantage from an orbiting observatory . . .

NIMBUS ADVANCED VIDICON CAMERA SUBSYSTEM
J. E. Keigler, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Program Review, 1962, 23 p., N63-18618.

OPTICS AND SPACE RESEARCH
E. H. Linfoot, Royal Astronomical Society, Quarterly Journal, vol. 4, Dec. 1963, p. 376/390, 10 refs., A64-15521.

Astronomical telescopes carried in satellites offer the possibility of obtaining much sharper images at large apertures because the light no longer has to pass through a turbulent atmosphere before reaching the telescopes. However, the problem of getting the information in the image back to Earth is a serious one . . . relation between the quality of the image and the minimum transmission time at prescribed power and bandwidth is considered, first in general terms by an application of information theory, secondly for a radio link using 5-bit pulse code modulation (PCM). The general formulas are applied to discuss the problem of designing a Moon-orbiting telescope to obtain pictures of the lunar surface with a resolution of 1 meter. . . .

THE VIDICON CAMERA TUBE AS AN ASTROPHOTOGRAPHIC INSTRUMENT
L. R. Malling, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 151/155.

SPACE ASTRONOMY AND THE SLOW-SCAN VIDICON
L. R. Malling, Rept. from J. Soc. Motion Picture Television Engrs., vol. 72, Nov. 1963, p. 872/875, refs., N64-14846.

Space astronomy is defined. In particular, the requirements for visual exploration of the Moon and Mars are outlined. The slow-scan vidicon is shown to be particularly useful as an astrophotographic instrument for space astronomy. The special instrumentation requirements for a slow-scan vidicon system are described for a Mars mission. Some of the techniques are illustrated with photos taken with a slow-scan vidicon system using as an optical objective the Mt. Wilson 60-inch telescope.

TELEVISION CAMERA FOR A GEOLOGICAL SURVEY OF THE PLANET MARS
L. R. Malling, IN: International Symposium on Space Technology and Science, Tokyo, Japan, August 27/31, 1962, 4th, Proceedings, Edited by Tamiya Nomura, Tokyo, Japan and Rutland, Vt., Japan Publications Trading Co., 1963, p. 549/557, 5 refs., A64-15034.

Description of a proposed television camera system for the photographic survey of Mars . . . electrostatically operated Vidicon camera tubes are used. Ruggedized electrostatic tubes are available that will withstand sterilization temperatures of over 125° C . . . both cameras take pictures continuously and alternately following planetary acquisition. With a stored picture read-out time of 10 seconds, and with interleaved camera operation, several pictures may be taken per minute . . . When this tube is combined with a suitable information encoder, a capability is then established for transmitting pictures over a narrow-band communication system back to Earth over planetary distances.

THE TV TELESCOPE
W. H. Manning, Jr., Astronautics and Aerospace Engineering, vol. 1, July 1963, p. 36/40, A63-18582.

. . . characteristics of the image orthicon . . . found to have approximately 1,000 times the sensitivity of high-speed film with an equivalent resolution of 20 line-pair/mm for a 1,000-line system and 50 line-pair/mm for a 2,500-line system, corresponding to film ASA with ratings of 800 to 200. Image information that requires greater resolution can thus be recorded by increasing the focal length, producing a larger but less bright image. . . .

READY FOR SKYHOOK, AIMING A 3-TON TELESCOPE HANGING FROM BALLOON
E. R. Schlesinger, Repr. from Electronics, 8 Feb., 1963, 6 p., refs., N64-14258.

Staroscope II, an unmanned balloon-borne 36-in.-diam. astronomical telescope . . . weighs over 3 tons and with its flight train is over 650 ft. high, is designed to provide consistent 0.1 sec-arc resolution photographs for exposure times up to 1 hr . . . include stellar guidance stabilization with a two-speed servo-control system, means for in-flight optical focusing, provision for in-flight programing of the optical and electrical system that selects different targets, and highly versatile command and telemetry links.

Related Publications:

TELEVISION CAMERA TUBES FOR RECONNAISSANCE
M. R. St. John, Proc. Nat. Aerosp. Electronics Conf., vol. 9, May 1961, p. 126/131.

FINE GUIDANCE SENSOR FOR HIGH PRECISION CONTROL OF THE OAO
N. A. Gundersen, American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., June 17/20, 1963, Paper 63-211, 12 p., A63-18437.

Description of the fine guidance sensor of the Cassegrain telescope which is to be mounted on the Orbiting Astronomical Observatory as part of the Princeton Experiment to investigate the extremely fine absorption lines which are expected to be observed when examining the radiation from selected stars. . . . electronics for signal processing . . . automatic gain control. . . .

3A.349: Other, Larger Input Subsystems

Included: Detection and warning subsystems; Special function generators as input devices; Reading devices for the blind; Sensory prostheses; Nuclear explosion detection subsystems; Chemical warfare detection and warning sensors; Optical scan pen.

Not Included: Design of function generators.

Cross References: Nuclear radiation sensors (3A.335).

Principal Publications:

A METHOD FOR SYNTHESIZING THE WAVEFORM GENERATED BY A CHARACTER, PRINTED IN MAGNETIC INK, IN PASSING BENEATH A MAGNETIC READING HEAD
I. Flores, et al., IRE Trans. Electronic, Comp., vol. EC-7, no. 4, Dec. 1958, p. 277/282.

When a character printed in magnetic ink passes beneath a magnetic reading head it generates a waveform. A method is described here to determine this waveform from the geometry of the printed character. The character shape is divided into elementary vertical units and the height of these units is then tabulated. A single set of experimental data is obtained in the laboratory by passing a magnetically printed bar beneath the same reading head which will be used to read the characters. . . . A method is then described for programming a high-speed digital computer to derive the waveforms.

CHEMICAL WARFARE DETECTION AND WARNING SYSTEM
J. G. Myers, Beckman Instruments, Inc., Fullerton, Calif., Rept. for 11 Aug.-22 Dec. 1961 on CW Detection and Warning Equipment, ASD TR 61-710, March 1962, 32 p. incl. illus., AD 275 380.

The basic requirements of Long Path Infrared (LOPAIR) systems for detecting and warning of the presence of chemical warefare (CW) agents are discussed. . . .

PRINT RECOGNITION APPARATUS FOR BLIND READERS
J. H. Davis, J. Brit. Instn. Radio Engrs., vol. 24, no. 2, Aug. 1962, p. 102/110, 13 refs.

. . . The facilities offered both to designer and reader by the auditory and tactile types of reading machine are compared. . . . actual machines . . . problems of recognition of the electrical signal and storage and accessibility of the sound tracks in the auditory machine are discussed. . . .

DETECTION OF NUCLEAR EXPLOSIONS IN SPACE AND UNDERGROUND
J. Maddock, J. Brit. Instn. Radio Engrs., vol. 23, no. 6, June 1962, p. 415/427.

. . . Detection instruments may be carried in satellites. . . . various techniques are reviewed. Seismic methods for the detection of underground explosions are discussed. Signal/noise ratio problems predominate and a seismometer array is described which provides discrimination against waves from different sources. . . .

GENERATING COMPLEX WAVEFORMS
A. V. Petrenko, et al., Electronic Design, vol. 10, March 1962, p. 130/132.

A complex waveform generator which employs an electron-optical servomechanism and which can produce voltages of practically arbitrary waveform is described. A CRT electron beam traces the shape of the mask on the CRT screen. Light from the screen is sensed by a photomultiplier which generates a voltage to control the beam path.

OPTICAL SCAN PEN
National Cash Register Co., Hawthorne, Calif., Final engineering rept., Technical pub. no. 3455, 11 April 1962, 1 vol. incl. illus., tables, 3 refs., AD 276 661.

. . . a manually held and manually moved scanning device that scans binary coded decimal marks. Feasibility has been proven and the practicality of aligning the pen to the printed marks was established. Specifications for the printing of Scan Pen Code were established.

PROBABILITY CHARACTERISTICS OF SENSOR OUTPUT DATA
G. W. McClure, et al., Michigan U., Ann Arbor Inst. of Science and Tech., Memo-2900-329-R, Sept. 1963, 34 p., 9 refs., N63-21405.

. . . First results of a program to determine the statistical nature of surveillance sensor output data. Most of the data were obtained from negative transparencies of vertically oriented aerial photographs. Smaller sample of radar and infrared films are reported for comparison. A line-scan process was used to generate an electrical analog of the light transmitted by the film. This signal was sampled, amplitude quantized, and recorded for later statistical analysis by a digital computer . . .

Section 3A. 35

3A. 350: Tape Recording Techniques

Included: Magnetic tapes; Reliability of magnetic tapes; Magnetic recording heads; Standards for magnetic recording techniques; Dynamic range of magnetic recording channels; Recording of variable intensity; Biased magnetic recording; High density recording techniques; Thermoplastic tape transport; Saturation magnetic recording.

Not Included: Theory of magnetic materials.

Cross References: Magnetic tape recorders (3A. 360).

Principal Publications:

A FIGURE OF MERIT FOR SINGLE-PASS DATA RECORDING SYSTEMS
J. H. Mulligan, Jr., IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 48/54.

The problem of the interference caused by eddy current transients to the reproduction of recorded data is studied for single-pass magnetic recording systems of both the write-read and read-write variety. Signal-to-interference ratios are introduced for both modes of operation, and their variation is studied in detail.

HIGH DENSITY MAGNETIC TAPE RECORDING OF DIGITAL DATA
M. A. Wells, Nat. Telem. Conf., May 1959, p. 188/205.

MAGNETIC TAPE RECORDING AND REPRODUCTION
H. J. Brown, Proc. Instn. Radio Engrs. Australia, vol. 21, no, 12, Dec. 1960, p. 867/879.

HIGH DENSITY DIGITAL MAGNETIC RECORDING TECHNIQUES
A. S. Hoagland, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 2/11.

A comprehensive, yet general readback simulation program is described which will automatically, for any characteristic pulse, simulate all possible readback signal patterns and test them for specified reading logic as a function of bit density. Amplitude, phase, peak, etc., sensing are compared and the influence of parameter variation on performance indicated.

THE MECHANICAL CONSIDERATIONS OF MAGNETIC RECORDING HEADS
M. B. Martin, J. Brit. Instn. Radio Engrs., vol. 20, no. 11, Nov. 1960, p. 977/885.

. . . discussion of the mechanical limits imposed on magnetic recording heads by the required performance specification. . . . manufacturing problems . . . effects of mechanical variations on the head performance. . . .

THE ASSESSMENT OF THE RELIABILITY OF MAGNETIC TAPE FOR DATA PROCESSING
R. Noble, J. Brit. Instn. Radio Engrs., vol. 20, no. 10, Oct. 1960, p. 737/742.

TRANSISTORIZED MOTOR SPEED CONTROLS FOR SATELLITE TAPE RECORDERS
M. B. Pickover, Proc. IRE, vol. 48, no. 4, April 1960, p. 725/728.

HOW ENVIRONMENT AFFECTS MAGNETIC RECORDING TAPE
C. B. Stanley, IRE Trans. Space Electronics Telemetry, vol. SET-6, no. 1, March 1960, p. 19/24.

THE INFLUENCE OF MAGNETIC TAPE ON THE FIELD OF A RECORDING HEAD
E. D. Torre, RCA Rev., vol. 21, no. 1, March 1960, p. 45/52.

In making accurate measurements of the field of a recording head it is desirable to know the effect of magnetic tape. The method of images is used here to make a first-order correction on the field in the absence of tape. . . .

SOME ENGINEERING ASPECTS OF MAGNETIC TAPE SYSTEM DESIGN
D. W. Willis, et al., J. Brit. Instn. Radio Engrs., vol. 20, no. 11, Nov. 1960, p. 867/876.

A paper presented at a Symposium on Magnetic Recording Techniques held in London on 15th December 1959.

A NEW MODEL FOR MAGNETIC RECORDING
B. B. Bauer, et al., IRE Internat. Conv. Rec. vol. 2, March 1961, p. 61/68.

. . . in the past . . . largely portrayed in terms of models based upon the magnetic characteristics of the recording medium. The proposed new model has the virtue of presenting a unified and simplified picture of magnetic recording. The recording process is viewed as an interaction between the idealized properties of magnetic particles and the idealized geometry of the recording field.

MAGNETIC RECORDING OF SHORT WAVELENGTHS
M. Camras, IRE Internat. Conv. Rec., vol. 2, March 1961, p. 74/80.

Magnetic recording densities of 10,000 cycles per inch or more give rise to problems in recording heads, playback heads, record media, mechanical contact, and alignment. An analysis of these problems, and techniques for achieving high densities are described.

MAGNETIC RECORDING HEAD ADJUSTMENT AND ALIGNMENT DEVICES
R. B. Dyer, J. Brit. Instn. Radio Engrs., vol. 21, no. 6, June 1961, p. 561/563.

. . . considers the problems involved in mounting magnetic recording heads in a manner permitting ready adjustment to tape path, thereby avoiding losses inherent in non-adjustable mountings. Two constructions of the device are described, for professional and domestic grade heads respectively. . . .

THE MECHANISM OF AC BIASED MAGNETIC RECORDING
D. F. Eldridge, IRE Internat. Conv. Rec., vol. 2, March 1961, p. 69/73.

PERFORMANCE CHARACTERISTICS OF A HIGH DENSITY DIGITAL MAGNETIC TAPE RECORDING SYSTEM
A. Gabor, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 218/230.

THEORY OF MAGNETIC RECORDING OF VARIABLE INTENSITY
V. A. Geranin, Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 12, 1961, p. 55/62.

The magnetic field, output effect and surface induction of a magnetic recording of variable intensity on a powdered magnetodielectric tape carrier under conditions of contactless signal reproduction are determined. The final relationships include (as parameters) the distance between the operating surface of the tape and the reproducing head, the function which symbolizes the distribution of residual magnetization along the thickness of the carrier, and the magnetic permeability of the reproducing head core. The cases of longitudinal and transverse lateral recordings are investigated. . . .

FLUTTER IN MAGNETIC RECORDING OF DATA
C. B. Pear, Jr., IRE Internat. Conv. Rec., vol. 2, March 1961, p. 81/88.

A NEW APPROACH TO MINIATURE MAGNETIC TAPE TRANSPORT DESIGN
R. S. Anderson, Proc. Nat. Telem. Conf., no. 7-4, May 1962, p. 1/9.

TENTATIVE SPECIFICATION FOR TAPE, DIGITAL, TELEMETERING INSTRUMENTATION
R. F. Brown, Jr., National Bureau of Standards, Washington, D. C., Final Rept., NBS rept. no. 7483, June 1962, 22 p. incl. tables, AD 275 085.

. . . Classification procedures, applicable specification documents, qualification tests, test equipment, magnetic and physical properties pertaining to magnetic recording tape for digital telemetering instrumentation use are discussed. . .

CURRENT PROBLEMS IN MAGNETIC RECORDING
M. Camras, Proc. IRE, vol. 50, May 1962, p. 751/761.

ANALYSIS OF MAGNETIC RECORDING FIELDS
G. C. Feth, Commun. and Electronics, vol. 81, no. 62, Sept. 1962, p. 267/279, 10 refs.

ON THE DYNAMIC RANGE OF A MAGNETIC RECORDING CHANNEL
M. V. Gitlits, Radio Engng: Transl. of Radiotekhnika, vol. 17, no. 4, April 1962, p. 65/75.

The effect of irregularities in efficiency of ferromagnetic recording media and of tape-transport flutter on the dynamic range of a channel during direct magnetic recording of signals is analyzed as is the use of amplitude, frequency and pulse-width modulation. . . .

MODERN MAGNETIC RECORDING TECHNIQUES
M. W. Johnson, Proc. Instn. Radio Engrs. Australia, vol. 23, no. 11, Nov. 1962, p. 647/652.

VARIABLE-SPEED RECORDER-REPRODUCER
T. Lanyi, et al., American Scientific Corp., Alexandria, Va., Quarterly progress rept. no. 1, 5 May-5 Nov. 1962, Rept. no. RR 1733, 27 Nov 1962, 112 p., AD 296 401.

. . . Deviations from conventional magnetic recording . . . unorthodox tape transport . . . Design and construction changes are described for changes from one-channel operation to a dual-channel system.

MAGNETIC TAPE RECORDING AT VERY SLOW TAPE SPEEDS
J. S. Mainstone, et al., Queensland U., (Australia), Technical Report No. 2, AFCRL-62-706, Sept. 1962, 26 p., 1 ref., N63-23595.

MAGNETIC RECORDING STANDARDS
F. Nesh, et al., National Bureau of Standards, Washington, D. C., quarterly progress rept., 1 April-30 June 1962, NBS Rept. no. 7525, July 1962, 19 p., incl. illus., tables, 16 refs., AD 277 830.

. . . characteristics of magnetic recording tapes . . .

A BALANCED TWO-SLIT MAGNETIC HEAD
Yu N. Ratmanov, et al., Foreign Tech., Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 22 Aug. 1962, 3 p. incl. illus., Trans. no. FTD-TT-62-858 from Soviet Patent no. 141652, (687651), 2 Dec. 1960, AD 284 080.

RESEARCH ON THERMOPLASTIC TAPE TRANSPORT
T. Afra, et al., General Electric Co., Sunnyvale, Calif., Quarterly progress rept. no. 3, 1 Jan/31 March 1963, 31 March 1963, 87 p., AD 414 479.

. . . construction of a feasibility model of a high data-transfer rate thermoplastic tape transport for future application as a prime high-speed automatic data processing input-output equipment. . . .

ULTRA-RELIABLE MOTORS FOR SPACECRAFT TAPE RECORDERS
E. Bahm, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 265/270.

THEORETICAL AND EXPERIMENTAL EVALUATION OF RZ AND NRZ RECORDING CHARACTERISTICS
M. F. Barkouki, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 92/100.

RZ and NRZ recorded pulse characteristics are determined theoretically and verified experimentally. Quantitative expressions are derived for the pulse location, width, shape and amplitude as a function of input current, head-tape spacing and gap width. The analysis is based upon the arc tangent approximation for the head longitudinal field component and an empirical (also arc tangent) expression for the tape magnetization curve.

VIBRATION ISOLATION OF SATELLITE TAPE RECORDERS
J. H. Conn, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., Washington, NASA, Feb. 1964, 12 p., N64-15921.

A standardized method of shock and vibration isolation for satellite tape recorders has been developed . . . This system is now being used in the International Satellite UK-2 and will be used in the Orbiting Solar Observatory (S-57 model) . . .

DISCRETE TRACKS FOR SATURATION MAGNETIC RECORDING
L. F. Shew, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 383/387.

. . . The recording medium consists of discrete magnetic tracks separated by non-magnetic bands. Width of the magnetic tracks depends largely on the desired track density and maximum tolerable head-repositioning error.

GENERALIZED PULSE RECORDING
I. Stein, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 77/92.

Tape magnetization characteristics resulting from an input switching are analyzed from a general point of view. A previously developed theory is first applied to the simple switching between zero and saturation field levels to determine the recorded magnetization and recorded pulse shape. From this analysis the characteristics of RZ pulses can be determined.

A FAMILY OF TAPE RECORDER-REPRODUCER MECHANISMS EMPLOYING A NOVEL DRIVE TECHNIQUE
W. Storer, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 217/226.

. . . consists of: (1) General requirements . . . (2) A description of each of the tape transports developed and a summary discussion of the design principles and limitations of each. 10^8 Bit Recorder . . .

WIDEBAND MAGNETIC TAPE RECORDING TECHNIQUES
J. Stumberg, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR269 9990 1, 15 Dec. 1963, 64 p., AD 432 458.

CERTAIN CHARACTERISTICS OF MAGNETIC RECORDING SYSTEMS
A. I. Viches, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 4, April 1963, p. 72/79.

. . . linear theory . . . theoretical or experimental determination of . . . characteristics . . . analysis of the recording process. . . .

MAGNETIC TAPE STUDY
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 56/70.

Subject of study to determine its relative suitability for various spacecraft data storage applications. It is certain that the selection of tape can significantly affect recorder performance.

<u>Related Publications</u>:

STUDY OF REUSABLE PHOTOSENSITIVE ELECTRON RECORDING MEDIA
F. F. Hall, Jr., et al., ITT Federal Labs., San Fernando, Calif., Interim engineering rept. no. 4, 15 Jan. - 14 Aug. 1962, 31 Aug. 1962, 58 p., incl. illus., tables, 47 refs., AD 284 512.

TRANSIENT-FREE AND TIME-STABLE SIGNAL REPRODUCTION FROM ROTATING HEAD RECORDERS
E. Kietz, Rec. Nat. Space Electronics Symp., no. 4.3, 1963.

. . . The magnetic storage of radar or telemetry data is often accomplished with great advantages on recorders which use the rotating head principle . . . In this paper . . . improvements with respect to time-base stability on rotating head recorders which scan the tape in a direction perpendicular to the tape motion.

. . . development of an improved radar and telemetry pulse recording system which provides a timing accuracy of +10 nanoseconds with respect to a standard reference frequency. . . .

Section 3A.36

3A.360: Data Recording Equipment

Included: Mass storage facilities; Card random access memory (CRAM); PCM recording methods; Aircraft voice recording; Predetection recording methods; Wide band FM recording; Satellite tape recorders; Portable recorders for field use; Incremental tape recorders; Intermittent operation of recorders; Missile-borne magnetic recorders; Video tape recorders.

Not Included: Design and manufacture of recorders.

Cross References: Tape recording techniques (3A.350)

Principal Publications:

MAGNETIC RECORDER/REPRODUCER STANDARDS
IRE Trans. Telemetry Remote Contr., vol. TRC-3, no. 3, Dec. 1957, p. 20/22.

A COMPACT TELEMETRY RECORDER
G. E. Bower, et al., Proc, Nat. Symp. Telem., no. 5.4, Sept. 1958, p. 1/6.

. . . direct writing recorders . . . means of storing telemetered instrumentation data.

DATA PROCESSING WITH MAGNETIC TAPE RECORDERS
B. Thompson, Proc. Nat. Symp. Telem., no. 5.6, Sept. 1958, p. 1/8.

. . . instrument that can be applied to a wide variety of applications involving data acquisition and processing. . . .

PREDETECTION STORAGE OF TELEMETRY DATA USING WIDEBAND MAGNETIC TAPE RECORDERS
R. E. Klokow, et al., Proc. Nat. Telem. Conf., May 1960, p. 501/520.

RECENT ACHIEVEMENTS IN MISSILEBORNE MAGNETIC RECORDERS
M. M. Siera, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 41/48.

GSDS INSTRUMENTATION SYSTEM
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 26/28.

. . . consists of two 7-track magnetic recorders, a 36-channel direct-write ultraviolet oscillograph, a 8-channel hot-stylus recorder, signal conditioning equipment, a patch panel system, and a telemetry subsystem. . . .

THE COURIER RECORDER-REPRODUCER
J. P. Buffington, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 241/249.

THE COURIER RECORDER-REPRODUCERS
J. G. Frayne, et al., IRE Internat. Conv. Rec., Session 36, 1961.

A descriptive coverage of techniques used on a single-track serial recording system.

TECHNIQUE INVESTIGATION FOR AIRCRAFT VOICE RECORDING
F. W. Jefferson, National Aviation Facilities Experimental Center, Atlantic City, N. J., Final rept., Aug. 1961. p. 10, AD 270 201.

. . . To investigate several cockpit voice recording techniques for the design and development of a transport aircraft voice recorder system. Binaural recording, noise cancellation inserted prior to recording, and filter techniques such as combined T-notch and band-pass, voice intelligibility equipment singularly. . . . were investigated.

A PREDETECTION RECORDING TELEMETRY SYSTEM
G. N. Johnson, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 209/217.

Recent developments in Tape Recorder/Reproducers have allowed significant data collection and storage improvements in telemetry ground stations. Among these are predetection recording systems capable of handling higher bit rates.

FLIGHT TEST INSTRUMENTATION
M. A. Perry, editor, New York, Pergamon Press, 1961, 153 p.

. . . a magnetic tape recording in flight testing . . . 15 papers listed comprise the edited Proceedings of the First International Symposium sponsored by the Department of Flight, College of Aeronautics, Cranfield, in 1960. . . .

PCM RECORDING MODES
R. L. Sink, Proc. Nat. Telem. Conf., May 1961, p. 14-1/14-19.

. . . recording of PCM information from telemetry sources is far from similar in form among various users. . . .

AIRBORNE TAPE RECORDER FOR USE IN NUCLEAR ENVIRONMENTS
J. M. Vallin, Diamond Ordnance Fuze Labs., Washington, D.C., DOFL rept. TR-919, 20 June 1961. 66 p., AD 261 995.

. . . an airborne multitrack magnetic tape record and playback system was designed, constructed, and subjected to nuclear environmental tests that . . . designed specifically to record and playback, while airborne, the data from high-altitude nuclear weapon effects tests . . .

CARD RANDOM ACCESS MEMORY (CRAM): FUNCTIONS AND USE
L. Bloom, et al., Proc. Eastern Joint Comp. Conf., Dec. 1962, p. 147/157.

. . . new mass store, the NCR CRAM. The hardware and logic control features are discussed . . .magnetic card storage module, having 256 magnetic cards within a magazine. Any card can be selected at random and wrapped around a rotating drum for information transfer (reading and writing).

APPLICATION OF MODULARIZATION CONCEPT TO SATELLITE TAPE RECORDERS
P. T. Cole, et al., Proc. Nat. Telem. Conf., no. 2-3, May 1962, p. 1/17.

MASS STORAGE
A. S. Hoagland, Proc. IRE, vol. 50, May 1962, p. 1087/1092.

A CRITICAL STUDY OF MASS STORAGE DEVICES AND TECHNIQUES WITH EMPHASIS ON DESIGN CRITERIA
M. Jacoby, Conf. Proc. Nat. Winter Conv. Mil. Electronics, vol. 1, Feb. 1962, p. 165/179, 13 refs.

. . . a survey is made of all currently available or announced mass storage machines. . . . The controversial question of discs versus drums is analyzed . . .

FACTORS AFFECTING THE DESIGN AND PERFORMANCE OF PREDETECTION RECORDING SYSTEMS
O. J. Ott, Proc. Nat. Telem. Conf., no. 4-2, May 1962, p. 1/9.

MAGNETIC RECORDING IN AUTOMATION (In Russian)
V. N. Shadrin, Gosenergoizdat, Moscow, 1962, 120 p.

. . . discusses the fundamental principles of magnetic recording as applied to automation. . . .

HOW TO MAKE COMPUTER COMPATIBLE DATA TAPES
R. E. Wright, Control Engng., vol. 9, May 1962, p. 217/129.

LARGE CAPACITY MEMORY TECHNIQUES FOR COMPUTING SYSTEMS
M. C. Yovits, editor, New York, The Macmillan Co., 1962, 440 p.

. . . a collection of papers presented at the Symposium on Large-Capacity Memory Techniques for Computing Systems sponsored by the Office of Naval Research. . . . The papers can be broken down into approximately five main categories: random access, sequential, and fixed memories, memory organization, and curiosities, with considerable overlap among some groups.

MAGNETIC TAPE RECORDERS
W. E. Arens, JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./ Nov. 1963, p. 175/183.

. . . deep space application impose a number of new and unique constraints upon magnetic tape recorders. . . . must normally play back in exact synchronism with a spacecraft clock signal at a rate much slower than it records. Record-to-playback ratios greater than 1000:1 will be required to satisfy many forthcoming spacecraft mission needs.

The 10^6 Bit Magnetic Tape Recorder Development . . .

Mariner B Magnetic Tape Recorders . . .
Mariner C Magnetic Tape Recorder . . .
Future Development Requirements . . .

MAGNETIC TAPE RECORDING AND REPRODUCING OF ATMOSPHERIC NOISE WITH A WIDE DYNAMIC RANGE
E. C. Bolton, Rev. Sci. Instrum., vol. 35, March 1964, p. 377/380, A64-15313.

. . . can record and reproduce atmospheric noise with a dynamic range of 90 db. The frequency range is 1 to 25 kc with a one-half octave bandwidth and, by using frequency conversion, frequencies from 25 to 500 kc may be recorded with a maximum bandwidth of 10 kc.

EVALUATION OF COCKPIT VOICE RECORDERS
J. G. Dong, et al., Federal Aviation Agency, Atlantic City, N. J., Final rept., May 1963, 110 p., AD 418 310.

A PRECISION ENDLESS-LOOP MAGNETIC TAPE RECORDER FOR SPACE APPLICATIONS
R. C. Falwell, et al., Feb. 1963, 20 p., N63-13097.

PREDETECTION RECORDING STUDY
R. A. Hanson, Aerospace Conp., Los Angeles, Calif., Rept no. TDR269 4110 01 15, 25 Nov. 1963, 51 p., AD 433 046, N64-17897.

The report examines the predetection recording requirements of the Satellite Control Facility . . . The four basic techniques of recording data on magnetic tape are compared and a forecast of future requirements is made with the recommended recording technique given for each. . . .

TELEMETRY PREDETECTION RECEIVER RECORDER/REPRODUCER SYSTEM
H. Howe, Dynatronics, Inc., Orlando, Fla., Dec. 1963, 110 p., AD 436 029.

. . . Principal conclusions . . . recommendations for future equipment and design . . . Section 3 - Development and Manufacture of A 1.5 Megacycle Magnetic Tape Recorder/ Reproduce System by Consolidated Electrodynamics Corporation, Pasadena, California. . . .

A DIGITAL INTERMITTENT DATA FLOW MAGNETIC TAPE RECORDING SYSTEM
J. R. Kannolt, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 295/310.

A unique mechanical drive system with associated transistorized circuitry has been developed to allow digital recording on magnetic tape at varying data flow rates. The present system records on command at rates up to 40 characters per second with a packing density of 200 characters per inch. . . .

The system provides a direct link between the slow and intermittent outputs of data acquisition equipment and the high-speed input devices of data reduction equipment . . .

WIDEBAND FM RECORDING
P. Leeke, Instruments and Control Systems, vol. 36, Sept. 1963, p. 111/113, A63-25968.

. . . for recording detected telemetry data such as PCM, PDM, and FM/FM. . . .

A MAGNETIC DIGITAL RECORDING SYSTEM FOR FIELD USE
C. McCoy, Jr., et al., Naval Research Lab., Washington, D.C. Interim rept., NRL 6016, 15 Nov. 1963, 9 p., AD 430 890.

. . . Five basic sections . . . analog, sampling and quantizing, magnetic tape assembly, visual monitor, and system control. . . .At the time of sampling, the instantaneous voltage values are held on eight sample-and-hold circuits for sequential processing by an analog-to-digital converter. The converter encodes the values held on each circuit into binary digits consisting of ten bits and a plus or minus sign (11 bit word). . . . The magnetic tape assembly section consists of a 16-channel dual head, digital recorder which accepts the binary output from the converter. . . .

OPTIMAL SCHEDULING OF DISK FILE DATA TRANSFERS (Correspondence)
D. Mandelbaum, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 551.

DATA RELIABILITY OF THREE BELL A-1 MAGNETIC TAPE RECORDING SYSTEMS
H. L. Preble, Mitre Corp., Bedford, Mass., Rept. no. W5442, ESD TDR 63 172, Sept. 1963, 15 p., AD 419 183.

. . . data reliability of three methods of recording Bell A-1 digital data on magnetic tape . . . the following parameters were held constant: (1) type tape, (2) tape age, (3) position of information across tape (channel effects), (4) position of information along tape (reel effects), and (5) word length. . . . The results show that the three recording systems tested are adequate for their application. . . .

A MAGNETIC TAPE SYSTEM FOR THE CERN MERCURY COMPUTER
H. J. Slettenhaar, European Organization for Nuclear Research, Geneva (Switzerland), Data Handling Div., 21 Aug. 1963, p. 45, refs., N64-13050.

An Ampex TM-400 M magnetic tape unit has been connected to the CERN Mercury computer in such a way that reading and writing is in strict accordance with IBM magnetic tape specifications . . .

AN INTERMITTENT MOTION DIGITAL TAPE RECORDER-REPRODUCER
W. Storer, JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 222/229.

The use of tape transport mechanisms in both satellite and space probe vehicles has been well established. . . . the typical interplanetary instruments in the particle area invlove the use of devices such as ion chambers, G. M. tubes, etc., which are characterized by: (a) a very large dynamic range . . . (b) asynchronous operation both in time and in data output characteristics, and (c) a relatively low instantaneous digital output rate . . . These requirements suggest the desirability of a device capable of recording, uniquely, one bit at a time, placing such recorded bits on magnetic tape in a regular fashion, and having the capability of synchronous readout. A contract was entered into by JPL with Raymond Engineering Laboratory to develop this recorder-reproducer. The results of this development are described.

OSE DIGITAL INCREMENTAL/CONTINUOUS MAGNETIC TAPE RECORDER
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 43/46.

A digital tape recorder is being developed for the scientific operational support equipment (OSE) to be used in the Mariner C program. Kinelogic Corporation, Pasadena, California, is presently completing the final phases of the program. This recorder is being designed to bridge the gap between low-speed paper tape punch devices and costly high-speed magnetic tape recorders.

Related Publications:

MAGNETIC CORE LOGIC IN A HIGH-SPEED CARD-TO-TAPE CONVERTER
E. Bloch, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 169/181.

. . . describes a static magnetic shift circuit and the logical connectives derived from it. . . .

SOME NEW TECHNIQUES IN AIRBORNE DATA ACQUISITION
M. E. Harrison, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 884/895.

. . . present state of the art in data acquisition . . . recent improvements. Newly developed recorder systems . . . airborne magnetic tape recorder. . . .

A SIMPLE HIGH CAPACITY DIGITAL OUTPUT DATA STORAGE SYSTEM FOR SPACE EXPERIMENTS
V. E. Suomi, et al., IRE Nat. Symp. Space, no. 4-5, Sept. 1960, p. 1/9.

. . . for on board storage of data for use with satellite borne scientific experiments . . .

THE DESIGN OF A MAGNETIC-RECORDING-TAPE TRANSPORT FOR VERY-HIGH TIMING ACCURACY
G. V. Jacoby, Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 491/500.

A SUMMARY DIGITAL AND ANALOG ELECTROSTATIC MAGNETIC DISC DRUM RECORD DEVICES
P. T. Komiske, Applied Physics Lab., John Hopkins U., Silver Spring, Md., 22 March 1963, 98 p., AD 406 375.

. . . has been in orbit with no failures to date. . . .

MECHANIZATION OF THE NONREAL TIME DATA AUTOMATION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-25, July/Dec. 1963, p. 53/56.

The nonreal-time portion of the Science Data Automation system (NRT DAS) provides the necessary functions for acquiring science data during the planetary encounter phase of the spacecraft mission, and transferring these data to a tape recording in the telecommunications system. The complete DAS is described in Ref. 1. This report reviews the design constraints and hardware trade-offs involved in the design of the NRT system.

Section 3A.37

3A.370: Mechanical Output Devices

Included: High speed printers; Digital-to-voice conversion systems; High speed plotters; Tactile output devices; Tuned reed output devices; X-Y plotters; Data-to-speech converter; Digicall system speaking clock.

Not Included: Standard DP equipment.

Cross References: Electronic output systems (3A.380).

Principal Publications:

A NEW SIMPLIFIED AIRCRAFT DATA LINK
M. Cooper, IRE Trans. Commun. Syst., vol. CS-7, no. 2, June 1959, p. 133/136.

. . . The system herein described can readily be priced at a level which will permit even owners of low-priced aircraft to operate a link-data station. The basis of this system is a relatively simple binary logic known as DIGICALL, which is equally capable of operating as a selective calling decoder, a discrete message decoder, or a versatile encoder. . . . Transmission is possible utilizing several forms of modulation and detection.

HIGH-SPEED TERMINAL PRINTERS USING THE BURROUGHS ELECTROSTATIC TECHNIQUE
K. M. Kiel, IRE Trans. Commun. Syst., vol. CS-7, no. 2, June 1959, p. 125/129.

HIGH SPEED PLOTTER
R. L. Sapirstein, Nat. Symp. Space Electronics Telem., no. 2.3, Sept. 1959, p. 1/9.

HIGH-SPEED PRINTERS
W. A. Davie, J. Brit. Instn. Radio Engrs., vol. 20, no. 9, Sept. 1960, p. 675/683, 17 refs.

. . . distinction between serial and parallel printers and between stoppable and continuous running printers is drawn . . . comparison of on-line and off-line methods of connection . . . survey of printing principles used in high-speed printers . . . checking . . . future trends . . .

A HIGH-SPEED GRAPH PLOTTER
G. B. Kent, J. Brit. Instn. Radio Engrs., vol. 21, no. 5, May 1961, p. 451/455.

. . . digital graph plotter capable of plotting up to 10 points per second on foolscap size Teledeltos paper with an accuracy of 0.2%. The plotter simultaneously inserts the graph ordinates at preselected intervals. It employs transistors throughout. . . .

HIGH-SPEED PRINTING ON ELECTROFAX
R. G. Olden, RCA Rev., vol. 22, no. 3, Sept. 1961, p. 582/589.

DIGITAL-TO-VOICE CONVERSION
E. L. Ragland, Proc. Eastern Joint Comp. Conf., Dec. 1961, p. 135/156.

. . . describes a speech read-out method which uses between 1000 and 5000 words in the form of continuous time-wave-forms recorded photographically as variable-density sound tracks on a drum.

A MINIATURE TUNED REED SELECTOR OF HIGH SENSITIVITY AND STABILITY
L. G. Bostwick, Bell Syst. Tech. J., vol. 41, no. 2, March 1962, p. 411/424.

. . . a selective contacting device that is responsive only to sustained frequencies in a discrete narrow band and is insensitive to speech and noise interference. It is of small size suitable for use in a pocket-carried radio receiver and is sufficiently stable to permit 33 discrete resonant frequencies, spaced 15 cycles apart, in less than an octave between 517.5 and 997.5 cycles per second. It has a threshold sencitivity of about 35 microwatts and other operating characteristics that are essential in large capacity systems.

PRINTING EQUIPMENT FOR MEDIUM, INTERMEDIATE, AND LARGE SIZE COMPUTERS
Cresap, et al., Control Engng., vol. 9, Jan. 1962, p. 91/95.

The performance and capabilities of a wide range of computer printing equipment are tabulated.

DEVELOPMENT OF A DATA-TO-SPEECH CONVERTER
H. Johnson, Lebell, Don, Associates, Sherman Oaks, Calif., Final rept., Engineering rept. no. 61-101, RADC TR 61-305, 27 Aug. 1962, 10 p., illus., AD 290 679.

. . . long range design objective . . . is to operate on command of a computer at speech rates and fidelity approximating natural speech with a 10, 000 to 50, 000 word vocabulary. . . . model contains a random access photo-optical memory which stores 500 prerecorded words on film for photo-electric readout on command from a manual keyboard or paper tape. The specific design configuration is demonstrably extendable to a full size vocabulary at acceptable data rates and fidelity.

AN OPTIMIZED PRINTER PLOTTING SYSTEM CONSISTING OF COMPLEMENTARY 7090 (FORTRAN) AND 1401 (SPS) SUBROUTINES PART I-INSTRUCTIONS FOR USERS
L.T. Dellner, et al., National Aeronautics and Space Administration, Lewis Research Center, Cleveland Ohio, NASA TN D-2174, April 1964, 31 p., refs., N64-18728.

AN OPTIMIZED PRINTER PLOTTING SYSTEM CONSISTING OF COMPLEMENTARY 7090 (FORTRAN) AND 1401 (SPS) SUBROUTINES PART II: SYSTEMS PROGRAMMERS MANUAL
L. T. Dellner, et al., National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio, NASA TN D-2175, April 1964, 114 p., refs., N64-18729.

The OPP system (Optimized Printer Plotting) . . . reduces 7090 execution time (by a factor of more than 10 from that required by presently available machine plotting methods), and produces printed plots at full printer speed (6 sec/page) as part of normal off-line output. This optimization is achieved by combining three techniques: (1) performing most of the requisite arithmetic on the 7090, (2) packing the results on the output tape (3) having the 1401 generate the grid and the grid-labels, as well as position the points in a subroutine of the standard tape-to-printer program.

A DEVELOPMENT STUDY OF THE PRINT MECHANISM ON THE IBM 1403 CHAIN PRINTER
B. J. Greenblott, Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 500/509.

TACTILE PRESENTATION OF VISUAL INFORMATION
K. Kotovsky, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 108/113.

Psychophysical experiments on tactile sensations were performed to determine parameters needed in the design of a tactile display containing about one hundred simulators. This tactile display is being used to present spatial and temporal patterns to the skin to investigate the pattern recognition capabilities of the tactile sense. . . .

NOW A TALKING COMPUTER ANSWERS INVENTORY INQUIRIES
L. H. Lee, et al., Electronics, vol. 36, Aug. 16, 1963, p. 30/32, A63-21397.

Brief description of a digital-to-voice translator (DIVOT) for use with a computer. To query the system, an inquirer dials the address containing the program which composes the answer. The program is read into DIVOT, where it controls the selection of auto signals from a prerecorded vocabulary, and transfers them at high speed to a playback buffer. . . .

AN ULTRA HIGH-SPEED LOW-COST PRINTER SYSTEM
J. A. Newnham, Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena, JPL-TR-32-465, Aug. 8, 1963, 13 p., N63-21904.

CONVERTING DIGITAL DATA TO VOICE
J. R. Rawley, Electronic Industr., vol. 23, April 1964, p. 84/86, A64-16941.

. . . a voice readout to supplement existing instruments . . . device must scan a digital readout display and convert the visual information to voice. The conversion is done with a multi-track audio tape drum and associated reed logic circuits.

A SURVEY OF X-Y PLOTTERS
P. A. Wright, British Commun. and Electronics, vol. 10, Oct. 1963, p. 782/787, A64-11038.

Listing of the principal manufacturers of X-Y plotter equipment chiefly available in Great Britain. . . .

NEW SPEAKING CLOCK USING MAGNETIC RECORDING
J. Brit. Instn. Radio Engrs., vol. 26, no. 3, Sept. 1963, p. 230.

After 27 years of continuous service, during which nearly 800 million calls have been made . . . the London speaking clocks (TIM) using optical recordings, have been replaced by a new installation using magnetic recording. . . .

HIGH-SPEED PRINTER AND GROUND TAPE RECORDER EVALUATION
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 39/43.

A General Dynamics 3070 high-speed printer and tape recorder have been tested in a system closely simulating actual spacecraft operating conditions.

As space craft checkout becomes more sophisticated more output data is produced at higher readout rates and it becomes evident that read out devices with more capability than these now in use must be made available.

Related Publications:

USE OF A DIGITAL READOUT UNIT IN CONVERTING SPECTROPHOTOMETRIC DATA TO COLOR COORDINATES
F. W. Billmeyer, Jr., J. Opt. Soc. Amer., vol. 50, Feb. 1960, p. 137/143.

. . . to enter spectrophotometric data on IBM punched cards . . . The cards are used as input to an IBM 650 computer to convert the color coordinates.

DIGITAL DISPLAY OF MEASUREMENTS IN INSTRUMENTATION
B. M. Oliver, Proc. IRE, vol. 50, 1962, p. 1170/1172.

Section 3A.38

3A.380: Electronic Output Systems

Included: Cathode ray tube output equipment; Alphanumeric visual display systems; Oracle curve plotter; Airborne insertion display equipment; Electroluminescent display techniques; Three-dimensional display systems; Display facilities for manned space flight; ELF display system; Solid state display panels; Character display systems; Air traffic control (ATC) display facilities; Data displays; Rho-rho computer display; Neon indicators; Digitron system.

Not Included: Space flight command centers (4); Television picture tubes.

Cross References: Mechanical plotters (3A.370).

Principal Publications:

A SOLID-STATE AMPLIFYING FLUOROSCOPE SCREEN
B. Kazan, RCA Rev., vol. 19, no. 1, March 1958, p. 19/34.

. . . By using photoconductive and electroluminescent materials, a thin solid-state panel has been developed which is comparable in form and size to the conventional fluoroscope screen. With X-ray intensities used in medical fluoroscopy, this produces a high-contrast image with a brightness of about one foot-lambert which can be viewed in moderate room light; however, seconds are required for image build-up. . . .

ORACLE CURVE PLOTTER
C. T. Fike, Commun. Assoc. Comput. Mach., vol. 2, Oct. 1959, p. 38/39.

ORACLE, a cathode ray tube curve and character plotter, is briefly described. Resolution is sufficiently fine to permit the use of both upper and lower case characters.

ANTICIPATORY DISPLAY DESIGN THROUGH THE USE OF AN ANALOG COMPUTER
L. J. Fogel, et al., IRE Trans. Aeron. Navig. Electronics, vol. 6, no. 4, Dec. 1959, p. 228/239.

A VERSATILE CHARACTER GENERATOR WITH DIGITAL INPUT
E. D. Jones, IRE WESCON Conv. Rec., no. 4, 1959, p. 16/20.

A device which will generate alpha-numeric characters and symbols from six-wire parallel binary character-sequential input information is described. The character generation is accomplished in a monoscope tube containing an aluminum target on which all of the characters and symbols are printed in an 8 X 8 matrix.

CHARACTER DISPLAY SYSTEM FOR USE AS DIGITAL COMPUTER OUTPUT
P.V.S. Rao, Rev. Sci. Instrum., vol. 30, Aug. 1959, p. 749/750.

A system in which the output of a digital computer is displayed as an arbitrary character on a memotron tube is described.

PROJECT MERCURY WORLD-WIDE TELEMETRY AND DISPLAY SYSTEM
D. Ferber, Proc. Nat. Telem. Conf., May 1960, p. 361/374.

HIGH-SPEED LIGHT OUTPUT SIGNALS FROM ELECTROLUMINESCENT STORAGE SYSTEMS
G. R. Hoffman, et al., Proc. Instn. Elect. Engrs. Pt. B., vol. 107, no. 36, Nov. 1960, p. 599/607.

. . . a matrix of electroluminescent cells could be used for storage of information in digital form. . . . It has been shown that the read-out time is limited by the afterglow of the phosphor . . . theoretical calculation . . . experimental panels . . . There is little doubt that considerable improvement in performance is possible. . . .

DISPLAY AND CONTROL REQUIREMENTS FOR MANNED SPACE FLIGHT
J. P. Loftus, East Coast Conf. Aerosp. Navig. Electronics, vol. 7, no. 6.2.4-1, Oct. 1960.

THE DIGITRON: A COLD-CATHODE CHARACTER DISPLAY TUBE
N. McLoughlin, et al., Electronic Engng., vol. 32, no. 385, March 1960, p. 140/143.

THE DIGITRON, A HIGH SPEED DATA DISPLAY SYSTEM
P. J. Meredith, Conf. Proc. Nat. Conf. Mil. Electronics, vol. 4, June 1960, p. 445/450.

. . . a high speed, alpha-numeric, visual display device, is designed to fulfill this need. The DIGITRON accepts digitally coded input information from a data processing system and translates this information into characters and symbols which are displayed on a cathode ray tube. . . . a real time, high speed visual display. . . .

A GLOW-DISCHARGE CHARACTER-DISPLAY TUBE
V. S. Perel'muter, et al., Radio Engng: Transl. of Radiotekhnika, vol. 15, no. 12, 1960, p. 108/112.

. . . for the indication of numeral symbols characterized by low power consumption and high efficiency in the conversion of electrical energy into light energy. . . .

ASYNCHRONOUS CIRCUITS FOR ENTERING DATA INTO AN ALPHANUMERIC VISUAL DISPLAY SYSTEM
E. L. Younker, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 828/829.

A visual display system is combined with a transistor driven magnetic core memory to provide a flexible means of storing and displaying numerical and alphabetic information. Storage is provided for 190 characters which are displayed on a conventional cathode ray tube (e.g. a TV picture tube) at a frame rate of sixty per second. Information can be inserted into the core memory manually by means of electromechanical keyboards and automatically from a magnetic tape. . . .

DYNAMIC THREE-DIMENSIONAL DISPLAY SYSTEMS
C. K. Auvil, et al., Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 139/143.

FERROELECTRIC SCANNING OF ELECTROLUMINESCENT DISPLAYS
M. Cooperman, RCA Rev., vol. 22, no. 1, March 1961, p. 195/205.

A CATHODE-RAY TUBE OUTPUT FOR A DIGITAL COMPUTER
R. L. Grimsdale, et al., J. Brit. Instn. Radio Engrs., vol. 21, no. 6, June 1961, p. 497/501.

The unit gives a visual display on one cathode-ray tube and has a second tube which is equipped with an automatic camera controlled directly by the computer. The device may be used for curve plotting with a resolution of 256 x 256 or for alpha-numeric display. In the latter case the computer can be programmed to display a variety of different formats and high output rates are possible. . . .

A SHIPBOARD SATELLITE POSITION DISPLAY
H. G. Talmadge, Jr., Naval Research Lab., Washington, D. C., NRL rept. no. 5638, 7 Aug. 61, 23 p., AD 263 436.

. . . will provide shipboard personnel with height, subsatellite position, and related information on up to ten selected satellites. It is assumed that corrected values of the orbital elements for all orbiting satellites will be transmitted weekly to the shipboard installation. Display details are presented, certain possible display configurations are outlined, an initial display proposal is presented, and modifications to produce a preferred display are discussed.

SOLID STATE DISPLAY DEVICE
S. Yando, IRE Internat. Conv. Rec., vol. 3, March 1961, p. 45/52.

A HIGH RESOLUTION ELECTROLUMINESCENT COORDINATE PANEL
P. F. Evans, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 340/344.

STUDY OF TELEVISION MULTIPLE INSERTION TECHNIQUES
E. Herud, DuMont, Allen B., Labs., Inc., Clifton, N.J., Final engineering rept., 25 Oct. 1957, rev. 1 Aug. 1962, 193 p. incl. illus., tables, AD 291 762.

. . . means of combining several moving images to form a composite picture, within a common background, is reported. Video insertion in itself is not new, but the method developed in this study is. Five separate targets may be included at the same time. These targets have the capability of moving independently of each other. Additional data has also been collected on general systems considerations, pickup and display devices, and equipment recommendations.

CRITERIA FOR GROUP DISPLAY CHAINS FOR THE 1962-1965 TIME PERIOD
E. J. Kennedy, et al., Rome Air Development Center, Griffiss Air Force Base, N. Y., Rept. no. RADC TDR 62-315, July 1962, 29 p. incl. illus., tables, AD 283 390.

. . . will meet most command and control systems requirements for the 1962-1965 time period . . .

GROUND DISPLAYS FOR FLIGHT MONITORING AND CONTROL OF THE PROJECT MERCURY MISSION
H. C. Kyle, Proc. Nat. Telem. Conf., no. 11-3, 1962, p. 1/12.

CONSTRUCTION AND PERFORMANCE OF AN ELF DISPLAY SYSTEM
E. A. Sack, et al., Proc. IRE, vol. 50, no. 4, April 1962, p. 432/441.

VISUAL DISPLAYS-LARGE AND SMALL
S. L. Smith, Mitre Corp., Bedford, Mass., ESD TDR 62-338, Nov. 1962, 12 p., illus., AD 293 826.

ELECTROLUMINESCENT DISPLAY TECHNIQUES
M. S. Wasserman, et al., General Telephone and Electronics Labs., Inc., Bayside, N. Y., Final rept. for 15 March 1961-15 March 1962 on Applied Communication Research for Air Force Vehicles, ASD TDR 62-586, June 1962, 78 p. incl. illus., 5 refs., AD 285 159.

The development of two solid-state electroluminescent (EL) display devices . . . The first is a compact, alphanumeric message display using EL display characters and photoconductive-electroluminescent (PC-EL) Circuits to translate 6-bit binary input information to the display code, to gate the information to the selected characters and to store the displayed information on each character. . . . The second combines unique properties of piezoelectric and electroluminescent materials. The basic panel requires only four properly timed electrical inputs to produce a spot of light. . . .

EVALUATION OF AIRBORNE INSERTION-DISPLAY EQUIPMENT
C. Yulo, et al., National Aviation Facilities Experimental Center, Atlantic City, N. J., Final rept., June 1962, 14 p. incl. illus., tables., AD 285 036.

. . . installation and checkout of the simplified Airborne Insertion-Display Equipment (AIDE) . . . Ground and flight tests were conducted to determine the capabilities and limitations of the AIDE. . . .

DIGITAL DATA PATTERN DISPLAY SYSTEM
E. J. Armata, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1425/1437.

. . . describes a data processing and display system that graphically represents digital data transmitted from a spaceborne vehicle in such a way that the operation of the payload can be rapidly evaluated. The digital data is converted to analog form and is presented in a pattern of dots and special symbols, representative of digitally coded information, in an X-Y coordinate form on a cathode-ray tube. . . .

GRAPHICAL DISPLAY OF MULTIPARAMETRIC INFORMATION. PART II EXPERIMENTAL STUDIES OF CHART DESIGN
H. M. Bowen, et al., Wright-Patterson AFB, Ohio, Behavioral Sciences Lab., Final Report, June 1963, 60 p., 32 refs., N63-22596.

. . . eight experiments conducted to determine standardized and acceptable formats for portraying multiparametric information. Factors investigated include optimum grid intervals, linear and nonlinear functions and scales, and chart complexity.

ELECTRONIC DATA DISPLAYS FOR AIR TRAFFIC CONTROL
D. W. G. Byatt, et al., IN: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, A64-12843.

Description of various electronic displays for the rapid handling of air traffic data. A block schematic shows a typical modern display system. . . .

RECENT TRENDS AND FUTURE DEVELOPMENTS IN RADAR DISPLAYS
D. W. G. Byatt, British Institution of Radio Engineers, Symposium on Processing and Display of Radar Data, London, England, May 16, 1963, Radio and Electronic Engineer, vol. 26, Dec. 1963, p. 459/467, A64-13493.

Description of a modern transistorized radar display capable of performing as a raw marked radar display and a synthetic display. Its three main operational units: the main time-base deflection amplifier, the high-speed symbol writing amplifier, and the video amplifier, are examined. . . .

VISUAL DISPLAYS OF INTEGRATED VIDEO WAVEFORMS
D. C. Cooper, J. Brit. Instn. Radio Engrs., vol. 25, no. 3, March 1963, p. 277/285.

. . . purpose of this paper to describe a set of experiments which have been performed to determine whether the performance of the deflection-modulated display can be improved by the use of suitable video processing. An electronic integration system was adopted and the processed video information was presented to an observer as a single deflection-modulated trace. . . .

A REVIEW OF DISPLAY TECHNIQUES FOR USE IN AIR TRAFFIC CONTROL
C. C. Fielding, In: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, A64-12839.

. . . optimum methods to meet the requirements of future air traffic control systems. . . . must be evolutionary over a period of perhaps a decade, and that, therefore, the accent must be placed on flexibility as far as display techniques are concerned.

RHO/RHO COMPUTER DISPLAY
H. Hammerstein, ACF Electronics Div., Final Engineering Report, Nov. 1963, 28 p., N64-19474.

The Rho-Rho Computer Display is a combined pictorial display and course-line computer operating from three DME inputs. Its place in the overall pictorial display evaluation program is merited by the higher accuracy of DME as compared with previous VORTAC pictorial displays. The equipment uses . . . slant range correction . . . sophisticated station-selection circuitry . . . and . . . high grade components. . .

A REALISTIC 3-D DISPLAY FOR A DATA PROCESSING RADAR
W. Hersch, In: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, A64-12842.

Description of a method suitable to present to a controller a three-dimensional celestial view of a volume of airspace. . . .

AN EXPERIMENTAL INVESTIGATION OF INTELLIGENCE INFORMATION DISPLAY PARAMETERS
A. J. Hoisman, et al., American Inst. for Research, Pittsburgh, Pa., Griffiss AFB, N. Y., RADC-TDR-63-378, Sept. 1963, 189 p., 23 refs., N63-23579.

. . . Information presentation parameters of visual displays used by Air Force intelligence analysts were investigated. Maps, linear graphs, and tables were chosen as the most representative means of display information . . . most potentially critical parameters: (1) density-defined as the total number of symbols in a given area; (2) density-defined as the number of symbol classes within a given area; and (3) color-coding . . . When performance is measured in terms of speed of response, graphs are the more effective display method; when the measure is accuracy, tables are the better method.

THE DISPLAY OF AUTOMATICALLY PROCESSED RADAR INFORMATION
D. R. Jarmen, J. Brit. Instn. Radio Engrs., vol. 26, no. 6, Dec. 1963, p. 469/476.

A system which uses a form of automatic radar data extraction followed by computer processing requires an output device in the form of a display, which accepts digital information and compiles it into a form which can readily be used by a controller. The display system described in this paper consists of a central equipment and a number of display consoles. . . .

PSYCHOLOGICAL EFFECTIVENESS OF A NEON INDICATOR
E. Laisk, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 6, June 1963, p. 516/517.

ALL ELECTRONIC DATA INPUT OUTPUT STUDY
W. E. Lepper, National Scientific Labs., Inc., Washington, D. C., Quarterly progress rept. no. 1, 1 July - 30 Sept. 1963, AD 427 865.

A general literature search for information related to hardcopy printing techniques was begun . . . Preliminary experiments to support general theoretical approaches to the proposed jet printing method were carried out . . .

ANNOTATED BIBLIOGRAPHY ON RECENT DEVELOPMENTS IN DATA DISPLAYS
C. F. G. Lyau, Autonetics, Downey, Calif., Rept. for 1961-1963, Rept. no. EM1163 155, AD 423 691.

. . . restricted to display techniques . . . which may have application to Command and Control Systems. . . .

DESIGN AND APPLICATION OF LIGHTED DISPLAY AND CONTROL
J. V. Manning, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 187/194.

. . . reviews the past seven years' developments and trends . . . a new and distinct tool for man's communication with today's elaborate military systems . . . capabilities of signalling and command. . .

PICTORIAL NAVIGATION DISPLAY
L. R. Miedzbrodzki, In: International Federation of Air Line Pilots Associations (IFALPA), Symposium on Supersonic Transport, London, England, Nov. 12, 14, 1963, Report, London, IFALPA, 1964, vol. 2, p. 273/275; Discussion, p. 281/283., A64-16449.

. . . giving a self-evident presentation, having the basic features of a map on which the pilot sees, as a spectator, a symbolic picture of the aircraft. . . .

AN INVESTIGATION OF ELECTROLUMINESCENT VIDEO DISPLAYS
C. J. Peterson, Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, Aug. 1963, 80 p., AD 420 967.

. . . phenomena of electro-luminescence, the operation of coincident-scan EL panels, the dynamic intensity requirements of video displays . . . characteristics of ferro-electric (FE) materials . . . operation of coincident transcharger arrays . . . determining the characteristics and feasibility of EL solid state television receivers . . .

DISPLAY AND CONTROL IN MANNED SPACE VEHICLES
A. Shulman, American Astronautical Society, Annual Meeting, 8th, Washington, D. C., Jan. 16-18, 1962, Proceedings. In: Advances in the Astronautical Sciences. Vol. XI., Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 271/298, 50 refs.

. . . particularly suited to the manual operation of manned space vehicles. A system plan has evolved that features closed-circuit television for presenting either symbolic displays derived from vehicle sensor data or television picture video from vehicle TV cameras. The system plan calls for the translation of sensor data and operator control commands to be carried out primarily by a digital control unit. The control unit is comparable to a special-purpose digital computer facility. . . .

INVESTIGATION OF THREE DIMENSIONAL DISPLAY TECHNIQUES
S. S. Verner, et al., Lockheed Electronics Co., Plainfield, N. J., Final Technical Rept., RADC TDR63 202, 30 March 1963, 120 p., AD 416 166.

A SOLID-STATE SELF-SCANNING DISPLAY DEVICE
M. S. Wasserman, General Telephone and Electronics Labs., Inc., Bayside, N. Y., RADC-TDR-62-601: TR-62-204 18, Nov. 30, 1962, 47 p., N63-15829.

ELECTRO-OPTICAL DISPLAY SURFACE
General Precision Lab., Inc., Pleasantville, N. Y., Final technical rept., RADC TDR 63 101, Nov. 1963, 77 p., AD 429 522.

. . . design, development, fabrication and test of a magneto-optical display surface, hereafter referred to as a Reflective Display.

. . . techniques of light absorbing and reflecting surfaces can be suitably controlled for application in large-scale data display systems.

. . . if effort is maintained, this magneto-optical display technique will lead to a successful large-scale display panel.

ELECTROLUMINESCENT FERROELECTRIC (ELF) SOLID STATE DISPLAY
Westinghouse Electric Corp., Baltimore, Md., Final rept., 30 June 1963, 1 v., AD 411 785

. . . experimental display panels utilizing electroluminescence and ferro-electricity have been constructed and evaluated. . . . Studies were performed on display panel resolution, gray scale, improved screen fabrication, and improved switching devices. Techniques of interconnection of modules to form a large area display have been formulated. Peripheral drive circuitry has been designed and developed for use with the ELF display panel. . . .

Related Publications:

HIGH SPEED DIRECT ELECTRONIC PRINTING CATHODE RAY TUBE
N. Fyler, et al., Conf. Proc. Nat. Conf. Mil. Electronics, vol. 4, June 1960, p. 623/629.

. . . called the PRINTAPIX . . . high definition electron beam used in this direct writing tube produces a charge pattern on an unsensitized dielectric surface such as paper or plastic through a unique mosaic printing head . . . The charge image, either line or continuous tone, is rendered instantaneously visible by adherence of a pigmented powder or floc . . .

TRACKING AND DISPLAY OF EARTH SATELLITES
F. F. Slack, et al., Proc. IRE, vol. 48, no. 4, April 1960, p. 655/663.

A NEW DISPLAY FOR FM/CW RADARS
H. H. Naidich, IRE Trans. Mil. Electronics, vol. MIL-5, no. 1, April 1961, p. 172/179.

DIVIDER-LOCKED PULSE-REPETITION-FREQUENCY SYNTHESIZER
P. O. Scheibe, Electronic Defense Lab., Mountain View, Calif., Technical memo. no. EDL-M452, 10 April 1962, 63 p., incl. illus. tables, 8 refs., AD 276 866.

. . . used in conjunction with a display as a means of eliminating synchronization problems caused by tape-speed fluctuations, in recording or playback of magnetic tape . . .

RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE
P. P. Damon, Vacuum Tube Products Div., Hughes Aircraft Co., Oceanside, Calif., Interim development rept. 24 June - 1 Oct. 1963, 5 Nov. 1963, 36 p., AD 428 609.

. . . capable of displaying stored information in either of two colors or in intermediate hues, and selectively erasing that information. . . .

DIGITAL DATA STORAGE AND DISPLAY USING A MAGNETIC DRUM AND CATHODE-RAY SCREEN
C. G. Lennox, et al., Atomic Energy of Canada Ltd., Chalk River, Ontario, May 1963, 42 p., 7 refs., N63-20020.

. . . of large quantities of information gathered in a complex industrial process, with particular regard to nuclear power-plants. . . .

ELECTROLUMINESCENCE: AN ANNOTATED BIBLIOGRAPHY
P. R. Stromer, Lockheed Missile and Space Co., Sunnyvale, Calif., Special bibliography, June 1963, 123 p., 263 refs., N63-18011.

The recent literature of carrier injection (d.c) and intrinsic (a.c.) electroluminescence has been reviewed. Electroluminescence is defined as the excitation of a phosphor by an electric field whereby electrical energy is converted to visible radiation. Other forms of energy such as photons, cathode rays, X-rays, etc., give rise to photoluminescence, cathodoluminesence, and X-ray luminescence, respectively. References to these other forms of luminescence, have been included only in those instances where they have been studied in combination with electroluminescence.

SPECIALIZED COMPUTER EQUIPMENT FOR GENERATION AND DISPLAY OF THREE DIMENSIONAL CURVILINEAR FIGURES
R. H. Stotz, Electronic Systems Lab., Mass. Inst. of Tech., Cambridge, ESL TM 107, March 1963, 154 p., AD 406 608.

. . . A straight-line-and-curve-drawing two-dimensional, axiometric projections of curvilinear three-dimensional figures at up to 100 times the speed of present point-plotting display scopes. . . .

Section 3A.39

3A.392: Other References about Peripheral Equipment

Included: Combined input/output equipment; Console type equipment; Communicating typewriters; Control consoles.

Not Included: Teletype equipment.

Principal Publications:

MESSAGE COMPOSING AND ENTRY UNITS
R. F. Geiger, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 27/32.

. . . The Message Entry Unit is an electronic device which provides for message composition, display for visual verification, automatic coding, and automatic entry of the message into the central processing system. . . .

ENGINEERING DEVELOPMENT LABORATORY (EDL) TEST REPORTS LAUNCH AND COMMUNICATION CONTROL CONSOLE
D. Gladish, Boeing Co., Seattle, Wash., Document no. T2 2564, vol. 3, Rev. A and B, 5 Feb. 1963, 1 v., AD 416 501.

. . . The Launch Control Console was inspected for physical appearances, conformance to engineering drawing and human engineering requirements . . .

AN INPUT/OUTPUT TYPEWRITER FOR COMMUNICATING WITH A DIGITAL COMPUTER
J. Mitchell, Mitre Corp., Bedford, Mass., Rept. no. TM3838, ESD TDR64 81, March 1964, 44 p., AD 435 108.

. . . a modification of a standard Selectric typewriter, has been designed for use with the Phoenix computer through the low-speed buffer or with the MITRE 7030 computer through the System Design Laboratory (SDL) display consoles.

DIGITAL BATTLEFIELD COMMUNICATIONS
W. C. Slagle, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, 289/293.

BASIC is digital communications equipment developed by Stromberg-Carlson - San Diego for the United States Marine Corps. The name BASIC stands for Battle Area Surveillance and Integrated Communications. . . . an electronic display on a CHARACTRON Shaped Beam Tube served as the output device. . . . The transmitted message contains 22 characters. . . . thumb-operated information switches . . . have 10 positions each, are marked for an intelligence application. . . . 10 digits of position information . . .

DIVISION 3A.4
DIGITAL PROCESSING METHODS

This division contains references to special digital processing methods which may be applied in space electronics subsystems or in special space communications units. These methods are in general more complex than those discussed in division 3A.2 under the heading of digital logical operations. On the other side it should be noticed that circuits and units applying these methods will, in general, not be considered as in independent spaceborne or ground-based processing system, such as will be discussed in division 3A.7 and 3A.8.

A general section is followed by section 3A.42 on digital function generators. There are references to pseudo noise sequence generators, random sequence generators, and also to computer programs for performing similar operations within a digital computer.

Section 3A.43 contains, in several subdivisions, information about special digital computing and control units, such as digital filters, correlators, comparators and others. Digital differential analyzers are a part of this section, though it is recognized that they could also be rated as a special group of independent computers.

Section 3A.44 comprises a number of digital code conversion methods and units performing such methods. Binary to decimal converters, serial to parallel translators, but also error control units and coordinate converters are the subjects of this section.

Beyond these more elementary methods there are methods for larger processing units operating on a stored program basis. Section 3A.45 contains references to such units, which are being used as programmed oscillators, antenna steering units and similar subsystems.

Section 3A.47 finally concentrates on message handling units, such as address readers, traffic loaders, number identifiers and other special purpose subsystems.

The reader may recognize that it is difficult to arrive at consistent sets of criteria for the classification of such digital processing methods and of the units performing them. It may be advisable to check several subdivisions when searching for a particular processing method.

Section 3A.40

3A.400: General Publications on Digital Processing Methods

Included: Books and surveys on digital computer engineering.

Not Included: Digital processing in business automation.

Cross References: Reviews on digital computers (3A.000); Computers in U.S.A. (3A.020); Computers abroad (3A.080).

Principal Publications:

DIGITAL COMPUTERS IN CONTINUOUS CONTROL SYSTEMS . . .
E. L. Braun, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 123/128.

. . . A comparison is made of the two major types of digital machines, namely the GP (general purpose) and the DDA (digital differential analyzer), and the characteristic feature of each are considered. . . . Methods of processing input data from analog and digital sensing elements are described, as well as means of supplying control signal to output servos.

DIGITAL COMPUTER AND CONTROL ENGINEERING
R.S. Ledley, New York, McGraw-Hill Book Co., Inc., 1960, 835 p.

There is little in the area of computer work which is not touched upon in some way by this book. Beginning with a discussion of computer use and programming, the book passes to such diverse subjects as numerical analysis, Boolean algebra, systems design, logical design and packaging, and circuit deisgn.

TWO-DIMENSIONAL SPATIAL FILTERING AND COMPUTERS
W.D. Fryer, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 529/535.

. . . principal purpose of this paper is to show how a broad and useful class of two-dimensional filtering operations can have notably shortened execution time in the digital case, and be put into a particularly convenient form for electrical filtering. . . . includes a reduction of dimension from two to one . . . An important class of smoothing filters, with weighting functions approximately Gaussian, is derived and used for illustration. . . .

DIGITAL PROCESSING
L. Schultz, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1963, 416 p.

SOME OPTIMUM PROCESSORS FOR MODERN COMMUNICATIONS AND CONTROL APPLICATIONS
A. H. Sepahban, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 768/792, 17 refs.

Engineering examples of data and signal processing problems from communications coding and control applications are presented to demonstrate the importance of a judicial selection of the mathematical approach to problem solution in the choice of optimum processor for each application . . .

. . . examples reviewed include a DDA (digital differential analyzer) processor for a time-optimal attitude control system; a z-transform processor for a high performance digital autopilot control; and a special purpose stored-program processor for message switching, signal detection and error correction coding for the communications subsystem of a modern command and control system.
Coding for signal detection by matched filter correlation of signal trains is compared with pure error correction coding. Digital processors for implementation of these two schemes are also compared.

Section 3A. 42

3A. 420: Digital Function Generation

Included: Random number generation; Discrete stochastic generators; Computer generation of random numbers; Generation of exponential random variables; Pseudo-random number generation; Error vector generation.

Not Included: Noise generators.

Cross References: Analog and hybrid function generation (3A. 520).

Principal Publications:

THE GENERATION OF PSEUDO-RANDOM NUMBERS ON ELECTRONIC DIGITAL COMPUTERS
A. R. Edmonds, Computer J., vol. 2, Jan. 1960, p. 181/184.

. . . program, Pegasus library routine R980, has been written for the Ferranti Pegasus for the choice of parameters . . .

HIGH-ORDER PROBABILITY GENERATORS (Correspondence)
R. B. Stone, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 92/93.

In the analysis of many postulated systems in the areas of economics, physics, etc., parts of the system can be represented by stochastic sources generating random numbers. Random number tables, or complicated numeric procedures for obtaining these numbers, are required to carry out the necessary calculations. Variable capacitance, microwave, parametric devices can be used to generate first-order binary sequences at megacycle rates . . .

ON A WEIGHT DISTRIBUTION PROBLEM, WITH APPLICATION TO THE DESIGN OF STOCHASTIC GENERATORS
A. Gill, Electronics Research Lab. U. of Calif., Berkeley, Feb. 1962, 12 p., AD 415 998.

. . . realized by feeding a deterministic finite memory sequential network from an arbitrary random source. It is shown that the problem of designing such a generator in an optimal fashion, or subject to some accuracy criterion, is equivalent to a weight distribution problem arising in various transportation and scheduling tasks . . .

FACTORIZATION OF POLYNOMIAL MATRICES
J. Towber, JPL Space Progr. Summ., vol. 4, no. 37-17, Aug./Sept. 1962, p. 60/61.

In connection with the generation of Gaussian noise with prescribed frequency spectrum by random number techniques on a digital computer . . .

GRAPHICAL DATA PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION
A. E. Brain, et al., Quarterly progress rept. no. 11, 1 Dec. 1962-28 Feb. 1963, March 1963, 39 p., AD 404 623.

A pattern may be presented for classification either as a code word of ones and zeros or of plus ones and minus ones . . . it has been found, by digital computer simulation that convergence is secured much more rapidly when the (+1, -1) representation of the input patterns is used. A discussion is presented of the machine logic and timing which have now been worked out in detail.

COMPUTER GENERATION AND TESTING OF RANDOM NUMBERS
L. J. Gannon, et al., Phillips Petroleum Co., Idaho Falls, Idaho, Atomic Energy Div., AEC, Natl. Reactor Testing Station, 20 Aug. 1963, 43 p., N64-11093.

. . . two methods most commonly used to obtain random numbers. These methods are the multiplicative congruential method and the mixed congruential method, and both methods involve somewhat arbitrary parameters . . .

ON A WEIGHT DISTRIBUTION PROBLEM, WITH APPLICATION TO THE DSEIGN OF STOCHASTIC GENERATORS
A. Gill, Electronics Research Lab., U. of Calif., Berkeley, 20 March 1963, 12 p., AD 408 451.

This paper is concerned with the design of a discrete stochastic generator (such as needed for implementing Monte Carlo programs or for simulating probabilistic finite-state machines), realized by feeding a deterministic finite-memory sequential network from an arbitrary random source. It is shown that the problem of designing such a generator in an optimal fashion, or subject to some accuracy criterion, is equivalent to a weight distribution problem arising in various transportation and scheduling tasks . . .

GENERATION OF ERROR VECTORS
A. Kobos, Rome Air Development Center, Griffiss AFB, N.Y., RADC-RAU-TM-63-6, Sept. 1963, 10 p., N63-23001.

. . . A method is presented by which any arbitrary waveform can be generated, using a minimum number of shift register stages and standard circuitry consisting of modulo-two adders, multipliers, and inverters. The particular case where the period consists of all possible binary n-tupules is examined. This is of interest because it contains all the error vectors which may be added in transmission . . .

A FAST PROCEDURE FOR GENERATING EXPOTENTIAL RANDOM VARIABLES
M.D. MacLaren, et al., Boeing Scientific Research Labs., Seattle, Wash., Mathematical note no. 283, Jan. 1963, 9 p., incl. illus., tables, 3 refs., AD 297 091, N63-21696.

. . . in a digital computer . . . The method is exact, in the sense that in theory it returns a random variable with exactly the exponential distribution. In practice the result is an approximation, but the accuracy of the approximation depends only upon the word length of the computer.

200 Mbit/s PSEUDO RANDOM SEQUENCE GENERATORS FOR VERY WIDE BAND SECURE COMMUNICATION SYSTEMS
R.A. Marolf, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 183/187.

. . . The generators are of the re-fed shift register type, whereby the shift register can easily be expanded by regular transmission lines to generate extremely long sequences. The Pumped Tunnel Diode Transistor Logic (PTDTL) circuit is used in the shift register and feedback logic circuit. Stable operation is ensured by wide tolerances on dc bias and "pump" voltages.

RANDOM NUMBER GENERATION OF THE BRL HIGH-SPEED COMPUTING MACHINES
M. L. Uncosa, Aberdeen Proving Ground, Md., Ballistic Research Labs., BRL-855, May 1963, 24 p., 7 refs., N63-22522.

. . . Procedures requiring very few orders and storage for generation of pseudorandom numbers on the ORDVAC, EDVAC, and ENIAC are described . . .

Related Publications:

AN INCREMENTAL COMPUTER TECHNIQUE FOR SOLVING COORDINATE ROTATION EQUATIONS
C.S. Deering, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 748/751.

. . . The method employes the basic incremental techniques used in a digital differential analyzer (DDA). However, the method differs from the usual DDA approach in that it takes full advantage of the possibilities for combining "remainder" or "R" registers. This results in a reduction of digital storage-capacity requirements.

HYBRID ANALOG-DIGITAL RANDOM-NOISE GENERATION (Correspondence)
R. Hampton, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 412/413.

Random-noise generators for random process and statistical studies with analog and hybrid analog-digital computers should produce noise signals whose amplitude distribution, dc unbalance, spectrum, and rms level is specified within the computer accuracy limits (0.1 to 0.5 per cent). In addition, the noise must be free from periodic components; noise samples must be uncorrelated for delays exceeding, say, one thousandth to one ten thousandth of a typical computer run.

Section 3A.43
Digital Computing and Control Units

3A.430: Digital Analysis Methods

Included: Amplitude distribution analyzers; Computer interpolation methods; Digital interpolation; Digital signal analysis; Computer analyzer programs; Digital spectral analysis; BOMM.

Not Included: Experimental evaluation of statistical populations in electronics systems (1); Smoothing methods (2).

Cross References: Analog spectrum analyzers (3A.520).

Principal Publications:

A TRANSISTORIZED AMPLITUDE-DISTRIBUTION ANALYZER EMPLOYING DIGITAL TECHNIQUES
D. Hoffman, et al., Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 478/489.

A method for determining the first probability distribution and the first probability distribution density of the amplitude of a random or periodic signal is described. . . .

SPECIAL PURPOSE ANALYSIS TECHNIQUES
R. Archbald, et al., New York U. Coll. of Engineering, N.Y., Quarterly rept. no. 2, 5 March-4 June 1962, on Feasibility Studies of Analysis Techniques for Various Signal Types, 4 June 1962, 75 p., incl. illus., tables, 3 refs., AD 285 286.

. . . The object of this study is the design of a frequency vs. azimuth display.

SPECIAL PURPOSE ANALYSIS TECHNIQUES
R. Archbald, et al., New York U. Coll. of Engineering, N.Y., Quarterly rept. no. 3, 5 June - 4 Sept. 1962 on Feasibility Studies of Analysis Techniques for Various Signal Types, 4 Sept. 1962, 85 p., incl. illus., tables, 5 refs.,AD 292 615.

. . . experimental setup of a computer analyzer for signal analysis problems . . . A computer program to compile and maintain a file of signals based on signal frequency and PRF is explained. . .

SPECIAL PURPOSE ANALYSIS TECHNIQUES
R. Archbald, et al., New York U., Coll. of Engineering, N.Y., Quarterly rept. no. 7, 6 July - 5 Oct. 1963, Oct. 1963, 45 p., AD 428 887.

. . . computer analyzer system . . . Additional circuitry for the miniature signal analyzer is described. . . . A system is described which is capable of analyzing and recording on film the pertinent characteristics of pulse-type signals.

A USER'S GUIDE TO BOMM. A SYSTEM OF PROGRAMS FOR THE ANALYSIS OF TIME SERIES
E.C. Bullard, et al., Institute of Geophysics and Planetary Physics, La Jolla, Calif., April 1964, 118 p., AD 436 430.

. . . causes an electronic computer to perform arithmetic operations on time series. . . . main objectives were: (1) to enable a wide variety of data formats to be accepted without recording; (2) to allow gross errors to be removed automatically from the data; (3) to provide a considerable variety of arithmetic operations and leave the user free to choose the order in which they are applied; and (4) to allow further processes to be incorporated into the system. . . .

THE USE OF DIGITAL DATA SYSTEMS
L.W. Gardenhire, Proc. Nat. Telem. Conf., no. 3-1, May 1963.

. . . provides a method for selecting the proper sampling rate for sampled data systems. . . . based on a more realistic type of input data and actual filters, rather than ideal data and ideal filter response characteristics. The various errors produced are explained and their values predicted for various types of input data. Several methods of interpolating between samples are explained and a new process called computer interpolation is presented which allows for a reduction in required samples by using a computer to look at the correlation between several samples. . . .

A DIGITAL SPECTRAL ANALYSIS TECHNIQUE AND ITS APPLICATION TO RADIO ASTRONOMY
S. Weinreb, Research Lab of Electronics, Mass. Inst. of Tech., Cambridge, Technical rept. no. 412, 30 Aug. 1963, 119 p., AD 418 413, N63-22274.

Doctoral thesis . . . for the measurement of the autocorrelation function and power spectrum of Gaussian random signals . . . greatly reduces the amount of digital processing that is required. A review of the measurement of power spectra through the autocorrelation function method is given. The one-bit technique of computing the autocorrelation function is presented . . .

ASAP, AN AUTOMATED STATISTICAL ANALYSIS PROGRAM
International Business Machines Corp., Poughkeepsie, N.Y., Part One (of) Two-Part Final Report, 1963, 45 p., refs., N64-16735.

. . . ASAP does not require that the circuit equations be written and solved to produce a Monte Carlo statistical analysis. By using a nodal description of the circuit in an English text, free-format input style, ASAP will write the circuit equations, solve them algebraically, write and compile a FORTRAN subroutine, and run the statistical analysis . . .

Related Publications:

A NEW APPROACH TO THE FUNCTIONAL DESIGN OF A DIGITAL COMPUTER
R.S. Barton, Proc. Western Joint Comp. Conf., May 1961, p. 393/396.

. . . discusses some of the functional principles on the basis of which the Burroughs B-5000 computer is organized. In particular the concept of the "stack" is described and its operational features illustrated by means of a very brief example and two tables.

COMPUTER SIMULATION ROUTINE FOR RADIO FREQUENCY BACKSCATTER: SOME COMPUTER SUBROUTINES FOR THE ANALYSIS OF DIGITALIZED STATIONARY AND ERGODIC DATA
G.W. Evans, et al., Stanford Research Inst., Menlo Park, Calif., Technical rept. no. 3, May 1962, 22 p., incl. illus., 2 refs., AD 277 265.

INTRODUCTION TO THE THEORY OF FINITE-STATE MACHINES
A. Gill, New York, McGraw-Hill Book Co., Inc., 1962, 214 p.

. . . Drawing heavily on papers by Huffman, Moore, Mealy and many others, the author has written an introductory text considering fundamental analytic aspects of this theory. . . . of interest to applied mathematicians and engineers concerned with computation, communication and control.

OTSENKA PARAMETROV MARKOVSKIKH OB'-EKTOV (Evaluation of the Parameters of Markov Processes) (In Russian)
E. P. Maslov, Avtomatika i Telemekhanika, vol. 25, no. 1, 1964, p. 73/82, A64-15235.

. . . In particular, the case is considered in which the input and output control signals are introduced into a computer through channels with random additive noises . . .

LEARNING MATRICES AND THEIR APPLICATIONS
K. Steinbuch, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 846/862, 34 refs.

. . . According to the characteristic signals processed (binary or analog signals) discrimination must be made between binary and nonbinary learning matrices. In the case of the binary learning matrix the conditioned connections are a statistical measure for the frequency of the coordination of object characteristics and object meaning . . .

PROGRAM 461 TELEMETRY ALIASING ERROR ANALYSIS
Lockheed Aircraft Corp., Sunnyvale, Calif., Rept. no. LMSC A324768, 10 June 1963, AD 409 887.

. . . the telemetry system is described mathematically by the transfer functions of its significant blocks. . . Three different interpolation filter types are compared . . . The computation was performed on an IBM 7094 computer, with a program written so that system parameters could be easily varied.

3A.432: Digital Filters

Included: DIFAIR, an adjustable digital filter; Digital matched filters; Digital notch filters; Polynomial filtering.

Not Included: Filter theory; Network theory; Matched filter signal detectors (1); Sampling theory (1); Adaptive operations in communications systems (2).

Cross References: Digital function generators (3A.420).

Principal Publications:

DIGITAL DATA PROCESSING FOR FINITE MEMORY FILTERS
A.J. Monroe, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 49/56.

. . . This paper is concerned with . . . the analysis and/or synthesis of digital programs to operate on an input signal so as to give some particular desired output. . . . will include ordinary smoothing, smoothing with prediction and differentiation . . . smoothing with prediction and integration. . . .

POLYNOMIAL FILTERING OF SIGNALS
F. W. Nesline, Jr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 531/542.

. . . presenting the detailed properties of filters that regenerate a signal as a continuous, or as a discrete, polynomial in time. The properties of interest in design and evaluation are presented for polynomial outputs as high as third order. The formulas clearly show the interactions between input parameters, network parameters, and output parameters . . .

ADAPTIVE COMMUNICATION FILTERING
C.S. Weaver, IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. 169/178.

. . . It is desired to filter according to a mean-square error criteria. . . . filters . . . may be realized physically by the use of tapped delay lines, or they may be constructed as part of a digital computer program. On the computer they are capable of real-time filtering of many types of signals. Measurements taken of signal and noise give the information needed to adjust — in a straightforward manner —the filter parameters. . . .

DIFAIR, AN ADJUSTABLE DIGITAL FILTER
C.N. Pryor, Naval Ordinance Lab., White Oak, Md., Rept. no. NOLTR 62-171, 27 Sept. 1962, 9 p., illus., tables, 2 refs., AD 297 400.

. . . present device simulates such filters of the convolution integral once the desired impulse response is set into the selector switches.

DESIGN OF A DIGITAL NOTCH FILTER WITH TRACKING REQUIREMENTS
R. Carney, IEEE Trans. Space Electronics Telemetry, vol. SET-9, no. 4, Dec. 1963, p. 109/114.

. . . accomplished through formulation of a regression equation for application to sampled input and output values from the filter. . . . additional requirement calls for tracking and attenuating an input whose frequency is time-variable. In particular, a linearly (with respect to time) variable frequency is considered and discussed. . . .

DIGITAL FILTERS AND APPLICATIONS TO SEISMIC DETECTION AND DISCRIMINATION
J.F. Claerbout, Mass. Inst. of Tech., Cambridge, AFCRL 63 604, Feb. 1963, 89 p., AD 404 851.

The mathematics of filtering in discrete time are presented. Filters are defined for the purpose of (1) condensing waveforms into impulsive functions, (2) wave shaping, (3) noise suppression, (4) signal detection according to the criterion of maximum signal-to-noise output at an instant, and (5) the same over an interval. The behavior of the complex Fourier transforms of some of these filters is considered and connection is made with the theory of orthogonal polynomials.

A DIGITAL FILTER FOR SEPARATING HIGH- AND LOW-FREQUENCY COMPONENTS OF A TRANSIENT SIGNAL
T. L. Geers, et al., David Taylor Model Basin, Washington, D.C., DTMB 1795, Jan. 1964, 39 p., AD 432 277.

. . . separates a transient signal into high- and low-frequency portions and introduces no phase shifts or amplitude changes in either portion. A program written in FORTRAN for an IBM 7090 computer which will filter a sampled time-history record is presented. Simple formulas are given for estimating errors in the filter that are due to sampling and truncation of the continuous record. Application of the filter to signals produced by two or more physical sources is discussed.

ERROR PROBABILITIES FOR A DIGITAL MATCHED FILTER
M. Koerner, JPL Space Progr. Summ., vol. 4, no. 37-21, April/May 1963, p. 158/160.

As detection systems become increasingly complex in an effort to extract information from noisy signals in an optimum or nearly optimum manner, analog mechanizations become unwieldy and use of a digital computer . . . to perform the required data processing, becomes attractive. . . . the detection system is independent of the computer hardware and depends only on the manner in which the received signal is sampled and converted to digital form. The effect of sampling and quantization shall be the subject of this report.

APPLICATIONS OF DIGITAL FILTERING TECHNIQUES TO DATA PROCESSING
M.A. Martin, General Electric Co., Philadelphia, Pa., Missile and Space Div., In AF Missile Test Center New Data Reduction Methods to Improve Range Data 1963, p. 197/223, ref., N64-15320.

. . . Applications of the theory to filters used in smoothing, differentiation, interpolation, and power spectrum analysis of sampled data are discussed. . . . The quality of the information provided by filters designed from frequency domain considerations and precautions that must be taken in the use of these filters are pointed out.

STUDIES IN OPTIMUM FILTERING OF SINGLE AND MULTIPLE STOCHASTIC PROCESSES
S.M. Simpson, et al., Mass. Inst. of Tech., Cambridge, AFCRL 64 241, 30 June 1963, 140 p., AD 428 509.

. . . treats the design of discrete filters for detection of signals caused by nuclear explosions on digitized seismic recordings. . . . necessary formulas for realizing the filters on digital computers. . . . A corresponding development is given for multi-channel processes . . . The prediction problem for single stationary time series is reviewed and the least square and Kolmogoroff solutions given. . . . Heuristic use is made of the Hilbert space property of time series. A digital computer program for performing the Wiener-Masani factorization is discussed. . . .

DESIGN STUDIES
General Electric Co., Syracuse, N.Y., Feb. 1964, 19 p., AD 433 765.

. . . an experiment to demonstrate the principle of resolution improvement by digital filtering, using real signals from a buried object detector. This experiment is the System Performance Simulation Study . . .

Related Publications:

CONTROL THROUGH DIGITAL FILTERING BY SIGNAL DECOMPOSITION WITH APPLICATION TO HIGHLY ELASTIC BOOSTERS
J. Zaborszky, et al., IEEE Trans. Applic. Industry, March 1964, p. 87/98, 5 refs, A64-15862.

A digital filtering process is introduced, and its characteristics and accuracy analyzed with and without random noise. Ways are discussed for using this signal component separation digital filter in control systems. An application to a typical large booster is demonstrated by combined analog-digital simulation.

3A.433: Digital Correlators and Related Devices

Included: Digital integrators; Digital comparators; Digital discriminators; Discrete filters for digital data; DICOR; Digital autocorrelation methods.

Not Included: Correlation properties of binary sequences (2); Theory of correlation detection (2).

Cross References: Analog to digital conversion techniques (Sect. 3A.54); Analog spectrum analysis methods (3A.520).

Principal Publications:

DIGITAL INTEGRATOR DEVICE FOR PROGRAMMING SECOND-ORDER CURVES
A.A. Voronov, et al., Autom. Remote Control, vol. 20, Feb. 1959, p. 169/176.

A DIGITAL CORRELATOR BASED ON THE RESIDUE NUMBER SYSTEM
P.W. Cheney, IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 63/70.

. . . Areas of investigation include sampling, analog-to-residue conversion, logical design of the arithmetic units, residue-to-analog conversion, and modes of operation of the proposed digital correlator.

A PROGRAM FOR THE DETERMINATION OF THE AUTOCORRELATION FUNCTION AND POWER SPECTRUM ON THE IBM 650 TAPE-RAMAC COMPUTER SYSTEM
R.S. Huntzinger, Aeronautical Computer Lab., Naval Air Development Center, Johnsville, Pa., 26 March 1964, 42 p., AD 436 410.

. . . computing the auto-correlation, or more precisely the autocovariance, function for a set of raw data comprising a stationary time series and, on the basis of these computations, determining the power spectrum. The storage capabilities of the IBM 650 tape RAMAC system have made this program useful for the analysis of large quantities of data from a variety of sources. . . .

A 1000-CHANNEL DIGITAL DISCRIMINATOR AND WINDOW SELECTOR CIRCUIT
J.A. Ladd, et al., Atomic Energy of Canada Ltd., Chalk River, Ontario, AECL-1751, June 1963, 32 p., 3 refs, N63-20700.

. . . gives an output indicating whether an applied number is larger, or smaller, than a chosen number . . .

A DIGITAL INTEGRATOR FOR ON-LINE SIGNAL PROCESSING (Correspondence)
Y. Lundh, IEEE Trans. Electronic Comp., vol. EC-12, no. 1, Feb. 1963, p. 26/28.

A concept for approximate digital integration is presented. The integrator is equivalent to the RC-integrator (but has no drift) and has an arbitrary long time constant.

LINEAR DIGITAL CORRELATOR (DICOR)
M.H. Mott, et al., Navy Electronics Lab., San Diego, Calif., NEL 1194, 8 Nov. 1963, 32 p., AD 429 308, N64-17362.

. . . Its design evolved from investigations of matched filtering of coded pulse radar signals utilizing digital techniques. . . . to find an economical means of eliminating or reducing the strong-signal-capture effect which leads to complexity and high cost in digital matched filters. Laboratory performance of DICOR agreed with theoretical predictions for a seven-element coded signal. . . .

DISCRETE FILTERS FOR DIGITAL DATA
E.A. Robinson, Massachusetts Inst. of Tech., Cambridge, In its Studies in Optimum Filtering of Single and Multiple Stochastic Processes, 30 June 1963, p. 8/63, refs., N64-15481.

The following topics are discussed: (1) matched filters, (2) modified matched filters, (3) modified matched filters for a multiparameter model . . . (5) time-invariant filters . . . (7) spike filters, (8) time-varying filters, (9) detection filters . . .

Related Publications:

THE AUTOMATIC DETECTION OF RADAR TARGETS USING A DIGITAL INTEGRATOR
A.A. McCurrach, Royal Aircraft Establishment (Gt. Brit.), RAE Technical note no. RAD838, June 1963, 32 p., AD 412 472.

. . .experimental study . . . of the probability of detection of radar targets using a digital integrator. . . . probability of detection is expressed as a function of the radar signal/noise ratio. . . . comparison of the performance of an automatic target detector and that of a human operator and P.P.I. . . .

SEQUENTIAL ESTIMATION OF CORRELATED STOCHASTIC VARIABLES
C.G. Pfeiffer, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-445, July 1, 1963, 14 p., refs., N63-21047.

. . . Examples of sequentially correlated processes are given, and an application to the deep-space orbit determination problem is discussed.

OPTIMIZED DIGITAL MAPPING SYSTEM
IBM, Rockville, Md., Interim rept. no. 1, Feb.-1 May 1963, 30 May 1963, 47 p., AD 412 798.

The primary purpose of the DAMC Project is to optimize system hardware and computer programs . . . and to . . . evaluate alternate correlation techniques. . . . The system consists of a photo-digitizer unit for scanning and digitizing a pair of stereo aerial diapositives, specially written computer programs for use on a IBM 7090. Computer to perform a rectification, correlation, and ortho-correction on the digital photo data, and a photomap printer unit for printing the rectified photo or orthophotomap with or without contour and grid tic information. . . . particular emphasis on the non linearities associated with the CRT and optical equipment.

3A.434: Digital Differential Analyzers

Included: Digital differential shaft motion analyzer.

Cross References: Differential integrators and correlators (3A.433); Analog differential analyzer (3A.520).

Principal Publications:

SYSTEMATIC SCALING FOR DIGITAL DIFFERENTIAL ANALYZERS
A. Gill, IRE Trans. Electronic Comp., vol. EC-8, no. 4, Sept. 1959, p. 486/489.

. . . shows how the scaling constraints can be organized in a matrix form, and how optimal scales can be produced in a systematic manner. The proposed scheme, which can be programmed for automatic execution, is adaptable for DDA's operating in conjunction with general-purpose digital computers.

DIGITAL MODELS
A.V. Shileiko, Autom. Remote Control, vol. 20, Dec. 1959, p. 1638/1687.

. . . a survey in which digital differential analyzers, rate multipliers and related devices are described; all of these are classed as "digital models" because they "can be used for simulation in the true time scale of definite physical processes and, consequently, can operate as elements of automatic control systems."
Shileiko's paper has value as a tutorial for those with some knowledge of DDA's and as an indicator of Russian interest in the subject.

COMPUTER ENGINEERING (In Russian)
S.A. Lebedev (editor), New York, Pergamon Press, 1960, 184 p., translation.

. . . The longest paper (74 pages) is the one on the relatively unimportant topic of digital differential analyzers. The paper is largely a rewrite of well-known information, 21 of the 22 listed references being from American publications.

A DIGITAL DIFFERENTIAL SHAFT-MOTION ANALYZER
R. L. Lyon, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 829.834.

A system permitting measurement of the angle between two points in a dynamic shaft system using digital and incremental techniques is described. Low inertia incremental shaft transducers and transistorized logic were used to resolve 2-1/2 minutes of angle at shaft speeds up to 1400 rpm. Additional logic was used to compare the movement between these two transducers and sum the difference in a reversible binary counter. The output voltage for a suitable recorder is derived from a digital to analogue converter. The output deflection on the recorder is then proportional to the instantaneous angle between the two points in the dynamic shaft system. The analyzer is able to make 200,000 comparisons of position per second. . . .

A COMPARISON OF DIGITAL DIFFERENTIAL ANALYZER AND GENERAL PURPOSE EQUIPMENT IN GUIDANCE SYSTEMS
M.M. Dickinson, Commun. and Electronics, vol. 79, no. 52, Jan. 1961, p. 706/708.

DIGITAL DIFFERENTIAL ANALYZER
H. Banbrook, Litton Systems, Inc., Woodland Hills, Calif., Final rept., March 1960-Nov. 1962, ASD TDR 63 158, June 1963, 1 v., AD 413 321.

. . . radically new digital computer design techniques and more efficient computer mechanizations were required. . . . simplified system through new time-sharing techniques. . . . Numerical Stieltjes integration algorithms were derived and developed for input processing and internal computations. . . . Invention of second different computation and communication led to the first general (quotient) algorithm with multi-increment accuracy and a multi-transfer unit which, in cases, equals precision of conventional devices of twice the complexity. . . . serial-parallel arithmetic modal techniques were developed.

A SEQUENTIAL MAGNETIC-CORE STORAGE SYSTEM (Correspondence)
A.J. Lincoln, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 917/918.

. . . description of a ferrite storage system developed for use in a real-time digital differential analyzer (DDA) . . .

INCREMENTAL COMPUTER ERROR ANALYSIS
Q.C. Turtle, IEEE Trans. Commun. Electronics, no. 68, Sept. 1963, p. 492.498.

. . . Analyses of two types of computational errors inherent in digital differential analyzer (DDA) operation are presented. Even though the emphasis is on the statistical analysis of round-off error, truncation error is also discussed. . . Analysis of a high-resolution type of DDA is introduced as an extension to the theory. Examples . . .

LOGIC AND CIRCUIT CONSIDERATIONS IN THE DESIGN OF A DIGITAL DIFFERENTIAL ANALYZER TO BE USED AS A TEST TOOL FOR EVALUATION OF ADVANCED MEMORY DEVICES
J.R. William, Army Missile Command, Redstone Arsenal, Huntsville, Ala., Rept. no. RG-TR-63-8, 16 Jan. 1963, 15 p., incl. illus., AD 297 104.

. . . test tool for evaluation of advanced memory devices, digital to analog and analog to digital converters . . .

Related Publications:

THE EFFECTS OF NOISE THROUGH A RECTANGULAR-INTEGRATION PROCESS AND SOME SAMPLED SPECTRAL-DENSITY METHODS
P.R. Westlake, IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 3, Sept. 1962, p. 159/175.

. . . The arguments are cased in the form taken by a digital differential analyzer (DDA) integrator. . . .

HIGH SPEED RATE MULTIPLIER FOR DATA DISPLAY SYSTEMS
H.A. Whitted, Navy Electronics Lab., San Diego, Calif., NEL Rept. no. 1174, 2 July 1963, 70 p., AD 418 595.

A rate multiplier using digital differential analyzer (DDA) techniques, providing an output pulse rate of 5.25 Mc/s, and clocked at 10.49 Mc/s, was developed. The multiplier has been successfully tested and incorporated in a functioning digital sweep. . .

Section 3A.44

3A.440: Digital Code Converters

Included: Decimal to binary converters; Binary to decimal converters; BIDEC; Binary to gray code converters; Binary to ternary conversion; Baudot to fieldata code converter; Teletype to data format converters; Error control encoders and decoders; Binary error control coders; Coordinate converters.

Not Included: Theory of error correction codes (2).

Cross References: Analog to digital converters (A/D converters) (3A.542).

Principal Publications:

BIDEC — A BINARY-TO-DECIMAL OR DECIMAL-TO-BINARY CONVERTER
J.F. Couleur, IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 313/316.

Simple, high-speed devices to convert binary, binary coded octal, or Gray code numbers to binary coded decimal numbers or vice versa is described. Circuitry required is four shift register states per decimal digit plus one 30-diode network per decimal digit. In simple form the conversion requires two operations per binary bit but is theoretically capable of working at one operation per bit.

DECIMAL-BINARY CONVERSIONS IN CORDIC
D.H. Daggett, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 335/339.

. . . contains a unique arithmetic unit composed of three shift registers, three adder-subtractors, and suitable interconnections for efficiently performing calculation involving trigonometric functions.

COORDINATE CONVERTER COMPUTER STUDIES
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 19/21.

Located at the Goldstone Tracking Station is a coordinate converter computer built by the Computer Control Company (CCC) to JPL specifications and requirements. This computer, used in conjunction with a teletype code converter digital comparator unit, and a digital-to-analog converter, can provide position commands for the Goldstone antennas. . . .

BINARY-TO-GRAY CODE CONVERSION
G.D. Beinhocker, Instrum. Control Syst., vol. 34, Dec. 1961, p. 2267/2268.

TRANSISTOR MORSE-TO-TELEPRINTER CODE CONVERTER
J.F. Cunniff, et al., Commun. and Electronics, vol. 80, no. 54, May 1961, p. 178/181.

CODE CONVERTER STUDY
H. Landerer, RCA Defense Electronics Products, New York, Final rept., Rept no. CR61 419 19, 31 Aug. 1961, 48 p., AD 431 583.

. . . recommendations for a low-cost, small-size converter for use in the 480-L system. . . . conversion between Baudot and Fieldata . . .

AN ELECTRONIC DECODER FOR BOSE-CHAUDHURI-HOCQUENGHEM ERROR-CORRECTING CODES
T.C. Bartee, et al., IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. S17/24.

. . . for a communications channel. . . . can correct all combinations of five or fewer errors which occur during transmission of the 127-digit block and detect all occurrences of ten or fewer errors. The encoder consists of a 35-stage shift register with feedback and a small control unit. . . .

HIGH SPEED ENCODING WITH RESISTOR-TRANSISTOR-LOGIC CIRCUITS
S.C. Chao, Electronics, vol. 35, Feb. 1962, p. 48/51.

The use of resistor-transistor-logic circuits in high speed encoders is described. The design principles of a binary full-adder are extended to a multi-stage cascade-type binary encoder.

SIMPLE DECODERS AND CORRELATORS FOR CYCLIC ERROR-CORRECTING CODES
M.E. Mitchell, IRE Trans. Commun. Syst., vol. CS-10, no. 3, Sept. 1962, p. 284/290.

Several promising techniques for instrumenting error-correcting codes are briefly described. . . . consist of digital decoders for the binary symmetric channel and for the binary erasure channel, and analog word correlators for variable and low bit-rate operation. . . .

PERFORMANCE VS COMPLEXITY OF SOME NEW DECODERS FOR THE BINARY ERASURE CHANNEL
M.E. Mitchell, Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 36. Appendix E.

Summary only . . .

THE USE OF INFORMATION SETS IN DECODING CYCLIC CODES
E. Prange, IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. S5/9.

A class of decoding algorithms using en-coding-and-comparison is considered for error-correcting code spaces. Code words, each of which agrees on some information set for the code with the word r to be decoded, are constructed and compared with r. An operationally simple algorithm of this type is studied for cyclic code spaces A. . . .

DECIMAL-TO-BINARY CONVERSION USING OCTAL RADIX ARITHMETIC (Correspondence)
C.P. Rozier, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 708/709.

A RESEARCH STUDY OF IMPROVED CODING FOR MILITARY DIGITAL TELEVISION
R.V. Blerkom, et al., IBM Federal Systems Div., Rockville, Md., Quarterly rept. no. 1, 1 March-1 June 1962, rept. no. 2, 1 June 1962, lv., incl. illus., 29 refs., AD 282 855.

. . . to obtain more efficient digital television systems applied to intercommunications (video telephone), briefing, and observing hazardous operations. . . . methods are presented for representing a single frame of a television picture and a discussion of computer programs for simulating these processes in non-real-time is included. Experimental results . . .

BINARY TO TERNARY CONVERSION BY LINEAR FILTERING
J.K. Wolf, et al., Rome Air Development Center, Griffiss Air Force Base, N.Y., RADC TDR 62-230, May 1962, 8 p., incl. illus., 3 refs., AD 278 264.

A simple linear filter consisting of a delay element and an adder is described for converting a random stream of binary pulses into a stream of ternary pulses . . . Another simple linear filter is described for re-converting the stream of ternary pulses into the stream of binary pulses. . . .

MARINER R TELEMETRY TO TELETYPE DATA ENCODER
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 69/72.

. . . to convert the telemetry data format as received from the spacecraft at each DSIF station, to a format suitable for transmission over teletype or telephone lines. Each encoder has the capability of producing teletype tape and modulating tone keyers, used on voice circuits, simultaneously.

RECENT MODIFICATIONS TO COORDINATE CONVERTER
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 16/17.

The coordinate converter has been moved from the Pioneer site and installed at the Echo site. Operation at the new location has been successful for the Ranger 3 and 4 missions. . . . the console was expanded and rearranged to provide greater operator convenience.

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 96/98.

• . . . generate the ranging codes for the transponder as described in the section on code structure. . . . no attempt is made to make the transponder coders general purpose; equipment is limited to that required for a particular mission. . . .

CASCADED BINARY ERROR CODES. PART 2. DECODING ALGORITHM FOR COMPONENT CODES
W. Altar, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR 169 3250 42TN2, 21 Oct. 1963, 97 p., AD 431 842.

Cascading of well-behaved group codes of moderate size, such as the Golay codes and some Hamming codes, permits the generation of codes of large overall size which can be step-wise decoded using the exhaustive and convenient decoding algorithms of the component codes . . . An SDS 920 all-purpose digital computer has been programed to (a) instrument the Golay (23, 12), decoding algorithm and (b) execute a statistical survey of 80 different implementations of the algorithm, including computation of performance parameters. . . .

BCE-TO-ANGLE-READING CONVERTER EMPLOYS UNIQUE NEW ALL-MAGNETIC BCD DECODER AND READOUT
S. Barth, et al., Data Systems Engineering, vol. 18, Oct. 1963, p. 18/22. 36/38, A64-11598.

THE RULE OF BACK CODE CONVERSION AND ITS APPLICATION TO THE CONSTRUCTION OF CIRCUITS OF DIGITAL CODE CONVERSION
O.S. Belima, Joint Publications Research Service, Washington, D.C., In its Translations for Avtomatyka (Automation), v. 7, no. 3, 1962, 18 Feb. 1963, p. 42/53, N64-11532.

Circuits for the following code converters are discussed: (1) converter of decimal code into binary decimal and number-pulse codes; (2) converter of binary code into Gray's binary code; and (3) converter of binary code of numbers into a number-pulse and binary decimal codes.

TIME DECODING FOR SATELLITE TRACKING SYSTEMS
A. Demmerle, et al., Electronic Industr., vol. 22, Oct. 1963, p. 182/189 A64-13484.

Description of an error detection and correcting time decoder designed for use with satellite data reduction facilities . . . short-term perturbations in the time code will not produce an incorrect ouput from the decoder. . . . continually correlates the time words with the data. The decoder further decodes both a serial decimal (SD) time code and binary coded decimal (BCD) time code. . . .

A TRANSLATING DEVICE FOR BINARY PUNCHED CARDS
J.K. Friswell, et al., Royal Aircraft Establishment (Gt. Brit.), RAE TN IR22, Jan. 1963, 33 p., AD 407 143.

A SPECIAL PRINTING DEVICE WITH A TRANSFORMATION OF BINARY NUMBERS INTO DECIMAL EXPRESSED BY THE INTERNATIONAL TELETYPE CODE (In Russian)
A. Linek, et al., Ceskoslovenska Akademie ved. Ustav Mathematickych Stroju. Stroje na Zpacovaninformaci, no. 8, p. 121/134, 1962, AD 401 579.

TEST AND EVALUATION OF A BAUDOT-FIELDATA CODE CONVERTER, PAPER TAPE
A.E. Luke, Army Engineer Geodesy Intelligence and Mapping Research and Development Agency, Fort Belvior, Va., 9 Aug. 1963, 26 p., AD 424 022.

IMPLEMENTATION OF DECODERS FOR CYCLIC CODES (Correspondence)
L.D. Rudolph, et al., IEEE Trans. Inform. Th., vol. IT-10, no. 3, July 1964, p. 259/260.

This communication describes three methods of implementing "syndrome decoders" for cyclic group codes. . . .

A BINARY-TO-DECIMAL CONVERSION CIRCUIT
T. Teitel, Electronic Engng., vol. 35, March 1963, p. 180/182.

A binary-to-decimal conversion unit is described which has an in-line digital read-out. It is operated direct from a transistorized scaling unit and no moving parts are employed: a ferrite core saturable reactor of a special design has been developed as a switching element.

AN ERROR-CORRECTING PROCEDURE FOR THE PERFECT GOLAY (23,12) CODE
J. Widrewitz, RADC, Griffiss Air Force Base, N.Y., RADC RAW TM 63 7, Aug. 1963, 13 p., AD 415 421.

. . . particularly effective . . . the associated UNIVAC 1103A computer decoding scheme. Allowable range in probability of binary digit error is established. Finally, estimated minimum and maximum computer time required for the error-correction procedure is given.

Related Publications:

ON A WIRED-IN BINARY-TO-DECIMAL CONVERSION SCHEME
W.C. Lynch, Commun. ACM, vol. 5, March 1962, p. 159.

SCF COMPUTER PROGRAM SYSTEMS MANUAL UTILITY PROGRAMS
R.L. Kinkead, et al., System Development Corp., Santa Monica, Calif, Rept. no. TM705 012 01, 3 July 1963, 6 p., AD 412 538.

DECOCT converts a BCD octal number to its binary integer equivalent, a BCD decimal integer to its binary integer equivalent and a BCD decimal integer and fraction to its floating point equivalent.

Section 3A.45

3A.450: Stored Program Processing Units

Included: Stored program controllers; Digital control subsystems in space applications.

Cross References: Digital control units in computers (3A.250).

Principal Publications:

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 41/46.

Stored-Program Controller. The sequence of operations to be performed in ranging mission will be specified by the program which is loaded into the memory uinit of the stored-program controller (SPC). . . .

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 47/50.

Stored-Program Controller. The principal function of the . . . (SPC) is to perform arithmetic operations on numbers. The present unit can add, subtract, compare, and store numbers. Later the necessary controls will be added to provide for shifting, multiplication, and division. . . . Another closely-related family of operation are the bit-wise or logical operations which operate on individual bits of a word independently of operations performed on other bits. The third function of the A/U is to provide information to assist the control unit (CU) in directing the flow of the program.

DIGITAL CONTROL SUBSYSTEM FOR PROGRAMED LOCAL OSCILLATOR
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 32/38.

. . . developed for the control of a receiver local oscillator subsystem, the combined system being called the "programmed local oscillator." . . . to tune the local oscillator of the Venus radar receiver to the exact frequency of the doppler-shifted radar echo within an accuracy of $5{:}10^{10}$, or approximately 1 cps at a received S-band frequency . . .

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 83/90.

Stored Program Controller, Mod II . . . the fourth in a series of reports . . . The resulting machine is operable and capable of being used to conduct the helicopter experiments . . . The primary means for entering programs and data into the memory of the stored program controller (SPC) is the paper tape reader.

PAGES FROM "THE DIGITAL SYSTEM OF STORING AND RETRIEVING INFORMATION (AI-2048)"
A. F. Belov, et al., Joint Publications Research Service, Washington, D.C., JPRS-22930; OTS-64-21405, 27 Jan. 1964, 46 p., Transl. into English from the book "Tsifrovaya Sistema Nakopleniya i Obrabotki Informatsii (AI-2048)," Moscow, State Publishing House for Lit. on Nucl. Sci. and Eng., 1963, N64-14522.

. . . AI-2048 system is intended for measuring the spacetime and statistical distribution of values and for the preliminary processing of the obtained information . . . contains . . . input devices . . . the working memory . . . the arithmetic unit . . . the control unit . . . the console unit . . . output devices . . . the micro-program unit . . . the power supply . . .

MECHANICAL DESIGN OF A FUNCTIONAL ELECTRONIC BLOCK DIGITAL PROGRAMMER FOR MISSILE AND SPACE-BORNE APPLICATIONS
R.C. Frank, IEEE Internat. Conv. Rec., Pt. 6, vol. 11, March 1963, p. 202/209.

THE DIGITAL ADAPTIVE CONTROL OF A LINEAR PROCESS MODULATED BY RANDOM NOISE
C. Pottle, IEEE Trans. Automatic Control, vol. AC-8, July 1963, p. 228/234, 14 refs., A63-22502.

Description of a digital controller for the compensation of a certain class of linear time-varying processes. The process time variation may be rapid compared to the input signals and is assumed to be caused by modulation of a plant with known parameters by a number of correlated random disturbances. . . .

DIGITAL DATA PROCESSOR FOR TRACING THE PARTIALLY ILLUMINATED MOON
H.J. Wilcox, Commun. ACM, vol. 7, March 1964, p. 183/188, A64-15161.

. . . for observation of the sightline of the center of a partially illuminated Moon. . . . optical sensor, digital computer and tracker drive mechanism. . . . an optical telescope with a radial mechanical scanning mechanism was used that read out lunar sightline measurement information. This information is sequentially read into a special purpose digital computer that extracts the measurements and computes the error signals that drive the tracker to the appropriate attitude.

MOD III RANGING EQUIPMENT
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 62/73

... Designed primarily as a medium-speed, general purpose digital controller possessing flexible programmability and input-output diversity, the Mod III can be adapted readily to a multiplicity of control and computational applications.

PROGRAMMING AND DOCUMENTATION SUPPORT FOR THE STORED PROGRAM CONTROLLER
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 73/76.

One of the objectives in the design of stored program controller portions of the Mod II and III ranging equipment was to make the process of writing and running programs straightforward and logical from the viewpoint of the engineer or scientist. ... This report describes the documentation and programming required for the proper support of the SPC.

A RANGE-GATED LUNAR RADAR EXPERIMENT
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 38/44.

... This article describes the system concept in more detail, the programming of the stored program controller ... is also presented.

Related Publications:

THE AUTOMATIC MAP COMPILATION SYSTEM
S. Bertram, Photogrammetric Engineering, vol. 29, July 1963, p. 675/679, A63-20258.

... uses a small digital computer to position an electronically generated scan on estimated homologous points on a pair of diapositives. The resulting signals are then correlated and used to measure the height error. ... The system moves through a series of profiling sequences to expose simultaneously a new photograph (with the imagery moved so that it will appear in correct orthographic projection in relation to a selected scale) and an altitude chart showing the contour information. A complete compilation for normal 9 x 9-in. vertical photography is accomplished in about 1.5 hr.

A GENERAL PURPOSE INSTALLATION FOR THE INVESTIGATION OF IMAGE RECOGNITION ALGORITHMS
V.M. Glushkov, et al., Joint Publications Research Service, Washington, D.C., In its Principles of the Design of Self-Learning Systems, 21 Oct. 1963, p. 93/109, refs., N64-11036.

... A general-purpose scanning installation for the investigation of image-recognition ... is described. This installation, which is used to feed the information about the drawing into the digital computer, is computer controlled. Thus, it is possible to model any method of conversion of the drawing ...

O VYBORE PROGRAMMY I TAKTNOSTI V TSIFROVYKHA SISTEMAKH UPRAVLENIIA (Selection of Programs and Sampling Periods in Digital Control Systems) (In Russian)
V. L. Katkovnik, et al., Avtomatika i Telemekhanika, vol. 24, April 1963, p. 539/546, 12 refs., A63-19819.

... procedure for the selection of the optimum sampling period of the computer, in the presence of constraints in the continuous element of the system.

THE ILLINOIS PATTERN RECOGNITION COMPUTER - ILLIAC III
B. H. McCormick, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 791/813.

This report describes the system design of an all-digital computer for visual recognition. One processor, the Pattern Articulation Unit (PAU), has been singled out for detail discussion. Other units, in particular the Arithmetic Unit and the Taxicrinic Unit, are treated in reports listed in the bibliography.
The PAU has been shown to be a processor of fundamentally new design - its logical organization has no analog in the central processing unit of existing computers. The PAU is the first modular parallel processor which because of its digital organization is capable of more reliable visual identification than part analog/part digital preprocessors of much less generality and potential virtuosity; is faster than any presently suggested alternative realizable today at comparable cost; and can serve as a prototype to a new generation of parallel computers that will capitalize upon thin film and integrated semiconductor circuitry of the immediate future.

DESIGN OF AN ENCODER, CONVERTER, AND DISPLAY DEVICE.
S. Rubin, American Machine and Foundry Co., Alexandria, Va., Rept. for 4 Sept. 1962-30 April 1963, ASD TDR63 659. Oct. 1963, 168 p., AD 423 552.

... Conversion between binary and B.C.D. notation is accomplished by a fixed-program, special-purpose computer coupled to the navigational computer. ...

Section 3A.47

3A.470: Digital Message Handling Units

Included: Number identifiers; Message composing units; Autodata message switching systems; Message switching units; Store and foreard switching units; Buffer stores for digital messages; Line concentrators; Multi-sequence computers; Traffic loaders.

Not Included: Data transmission methods (1); Theory of MODEMS (1).

Cross References: Electronic switching centers (3A.554); Stored program electronic switching units (3A.555).

Principal Publications:

REALIZATION OF RANDOMLY TIMED COMPUTER INPUT AND OUTPUT BY MEANS OF AN INTERRUPT FEATURE
L. R. Turner, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 141/149.

. . . Lewis Flight Propulsion Laboratory of the National Advisory Committee . . . primary task of research into the basic problems of the design and operation of aircraft power plants. . . . 1952, the first model of an automatic digital data pressure recorder with mechanized, manually-controlled computing was put into operation. . . . central editing and computing station serves a number of remote research facilities.

THE MULTI-SEQUENCE COMPUTER AS A COMMUNICATIONS TOOL
J. N. Ackley, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 114/119.

. . . more than one sequence or program operates independently, time-sharing the central processing unit . . . becomes a very rapid and economical message switching center by connecting the communications lines as the input and output devices.

MESSAGE COMPOSING AND ENTRY UNITS
R. F. Geiger, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 27/32.

. . . The Message Entry Unit is an electronic device which provides for message composition, display for visual verification, automatic coding, and automatic entry of the message into the central processing system. . . .

AUTODATA — RCA'S AUTOMATIC MESSAGE SWITCHING SYSTEM
J. L. Owings, Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 616/623.

. . . describes the system design of an automatic store and forward type message switching center and will review the implementation of the system requirements with modern computer techniques. . . .

A CHANNEL SELECTOR APPLYING ERROR-CORRECTING CODES
S. Yoshida, et al., Rev. Elect. Commun. Lab., vol. 8, no. 11-12, Nov. - Dec. 1960, p. 540/548.

Channel selectors using toroidal ferrite cores are described. . . . Channel selection is achieved by suitable choice of the sense of the input windings on the core corresponding to each channel, so that an input whose bits correspond to the designation of a particular channel will produce a large output pulse in that channel, and small pulses in all others. . . .

SELF ADJUSTING AUTOMATS FOR DECODING MESSAGES (In Russian)
V. I. Levenshtein, Dokl. Akad. Nauk. SSSR, vol. 141, no. 6, Dec. 1961, p. 1320/1323, 12 refs.

. . . it is shown that an automatic device for decoding messages can exist if the coding system has the property of limited interruption; the automat can be self-adjusting (self-correcting) if the coding system has a self synchronizing property. The length of interruption caused by accidental misadjustment is found in terms of parameters of the coding system.

A LOW-COST NUMBER IDENTIFIER FOR SMALL TELEPHONE SYSTEMS
T. R. Redington, Commun. and Electronics, vol. 80, no. 54, May 1961, p. 117/121.

Inability to determine, accurately and economically, the calling line number in connection with direct distance dialing has hindered the extension of this service to small telephone systems. . . . Discussed herein is a new identifier, developed to handle this problem economically. . . .

A BUFFER STORE FOR DATA TRANSMISSION
W. E. Baker, et al., Commun. and Electronics, vol. 80, no. 58, Jan. 1962, p. 566/570.

A method is presented for connecting an information source emitting data at an arbitrarily fluctuating rate to a synchronous transmission system. Expressions are derived relating the fluctuating input data rate and the maximum transmission efficiency to the capacity of a buffer store necessary to establish this connection. An acoustic delay line buffer store whose input and output are independent of each other is described. The buffer store has a capacity of 45 bits, operates with 2 μ sec. (microsecond) spacing between pulses, and employs a unique method of generating a 500-kc timing signal. . . .

ON LINE DATA ENTRY SYSTEM
G. Beltz, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 452/454.

. . . acts as a line concentrator . . . as a speed changer . . . provides for query and reply message buffering at the processor interface . . . provides to the remote entry device and operator, many composing, checking and verifying features without tying up the processor in any way. . . . all ten I/O devices can operate simultaneously . . . allows the use of un-modified Teletype keyboard printers as I/O devices. . . .

MESSAGE SWITCHING AND RETRIEVAL IN A REAL TIME DATA-PROCESSING SYSTEM
E. T. Hall, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 190/197.

. . . incorporates data processing equipment similar to that used in an airlines reservation system. . . . A specific type of system was selected in order to describe the message switching functions in a multi-application environment . . .

MESSAGE BUFFERING IN A COMPUTER SWITCHING CENTER
G. Harrison, IEEE Trans. Commun. Electronics, no. 68, Sept. 1963, p. 532/534.

. . . The extreme cases of individual as against shared-line buffering are analyzed under the assumption of exponentially distributed message lengths. Finally, a method is indicated for increasing the accuracy of estimates of required storage capacity when the distribution of message lengths is known.

APPLICATION OF PULSE-CODE MODULATION TO AN INTEGRATED TELEPHONE NETWORK. Part 3—Switching
J. Le Corre, Elect. Commun., vol. 38, no. 1, 1963, p. 44/55.

. . . examination of the 3 main points. . . . A. Design of a switching stage connecting voice-frequency subscribers' lines to a pulse-code-modulation multiplex highway. B. Design of a switching stage for interconnecting pulse-code-modulation multiplex highways. C. Synchronization of the coded and multiplexed speech signals at the input of each exchange to which they are transmitted. . . .

APPLICATION OF A MODULAR DATA PROCESSOR TO STORE-AND-FORWARD MESSAGE SWITCHING SYSTEMS
F. G. Wolff, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 198/207.

In the store-and-forward message switching system, a message is delivered to the nearest "post office," where it is sorted and transmitted to proper destinations when facilities are available. The originator, in the meantime, is free to enter into other communication. . . . paper describes the application of a modular data processor, the large-scale, multiple-computer, Burroughs D825 system to an automatic switching center. . . .

Related Publications:

473L DPSS/ICSS INTERFACE DESCRIPTION
C. B. Brown, Mitre Corp., Bedford, Mass., Technical memo no. TM-3511, ESD TDR 63-160, 4 Dec. 1962, 1 vol., incl. illus. tables, AD 297 312.

The 473L Data Processing Subsystem (DPSS) communicates on a real-time basis with a number of input/output consoles comprising the Integrated Console Subsystem (ICSS). These consoles are of three types designated the AN/FYA-2, AN/FYA-3, and An/FYA-4 respectively and differing principally in the aggregation of major functional components provided in each.

THE DEGARBLER—A PROGRAM FOR CORRECTING MACHINE-READ MORSE CODE
C. K. McElwain, et al., Inform. Control, vol. 5, no. 4, Dec. 1962, p. 368/384.

. . . The program has access to a vocabulary and a table of the Morse Code equivalents of the English alphabet. The correction rate on text in which 0-10% of the characters have been subjected to Morse Code garbles is about 70%. The apparent improvement in intelligibility is very marked. . . .

RESEARCH ON MAGNETIC ROD STORAGE AND CONTROL UNITS FOR A SWITCHING CENTRAL OFFICE
D. Rork, et al., National Cash Register Co., Hawthorne, Calif. Final progress rept., 15 April 1961 - 30 Sept. 1962, Rept. no. 4, 30 Sept. 1962, p. 134, incl. illus., tables, AD 289 096.

The system has two basic units: a central exchange and one or more remote line concentrators . . . Each remote concentrator is capable of handling 60 subscriber lines with a maximum load of 15 subscribers at the same time. Communication between the remote concentrators and the central exchange is handled by a time-multiplex system consisting of 16 channels . . . The switching central, normally provides service for 240 subscribers. . . .

UNICOM. UNIVERSAL INTEGRATED COMMUNICATION SYSTEM
Bell Telephone Labs., Inc., Whippany, N. J., Progress rept. no. 18, 1 Oct.- 31 Dec. 1963, 31 Dec. 1963, p. 56, AD 434 182.

. . . system requirements for disposition of blocked store and forward messages were specified and teletypewriter input messages necessary for control of the store and forward units were reviewed. . . . Central controls are operational in the simplex modes, and PCM and vocoded speech were switched through the time division switch.

DIVISION 3A.5
ANALOG AND HYBRID PROCESSING METHODS

Electronic data processing methods, historically, started with certain analog processing methods which were able to solve systems of linear and nonlinear equations. Digital computing techniques took the lead in the next stage of the development of electronic calculators. During the six years of the reporting period of this bibliography it appears that a third period emerged: The period of the hybrid processors. A detailed error analysis of almost any computation process indicates that only certain phases and certain parameters of a computation process are influencing most critically the accuracy of the result, while many others do not require the high accuracy of a digital computer. As a result of such considerations "hybrid" computers emerged. These are systems which combine the advantages of digital and analog computing methods.

This division contains, in the first sections, references to general problems (3A.50 and 3A.51) and to purely analog units, such as analog function generators (3A.52) and analog control and computing units.

Section 3A.54 is devoted to converters between analog and digital information processing systems. Section 3A.55 then deals with one kind of hybrid information processing methods, the so-called sampled processors. Sampled information transmission methods have been discussed in Volume 1 under pulse communications systems. Here we consider applications in switching centers and in multiplexing systems.

Section 3A.57 and 3A.58, finally, deal with two classes of hybrid information processing systems of great importance in space communications systems. Both these classes have their real time (on line) operation as a common element. The difference between these two classes is not easy to specify and the reader is advised to consult both. One possibility is to define their differences by their position within a communications link from source to destination.

Signal conditioning subsystems have the task of accepting a plurality of inputs from various sensors and to process them in a form such that the information can be transmitted over a common link to a receiving station. The nature of most space missions calls for a maximum information flow from space craft to Earth and for a small but extremely vital information flow from Earth to space craft. This situation leads to the application of signal conditioning subsystems in the space craft with less or no requirement for such a subsystem in the ground station.

Signal processing subsystems on the other hand are assigned the task of receiving this combined information flow (composite modulated signal) and separating it in an optimum way from noise and disturbances. In space communications links it is not difficult to supply the ground transmitter with large power, but the space craft transmitter must operate with minimum power. The down-link will therefore be more contaminated by noise than the up-link. Unfortunately, the down-link usually has to carry more information, thus making it still more desirable to apply complex signal processing techniques in the receiving terminals of down-links.

However there are many applications where the signal conditioning function and the signal processing function may merge into a single signal handling operation. This is partly the case in radar signal processors, which are discussed in section 3A.58. Another such overlapping case are sensor systems for the reception, detection and identification of unknown (non-cooperative) communications signals. Such special situations are why the term signal processing in the above sense should be used with caution.

Section 3A.50

3A.500: General References on Analog and Hybrid Processing Methods

Included: Analog-digital computation techniques; Data reduction systems with analog and hybrid techniques; Analog computer engineering in general.

Not Included: Analog modulation methods (1); Analog coding methods (2).

Cross References: Analog computers in general (3A.002); Hybrid computation in general (3A.004).

Principal Publications:

ANALOG COMPUTATION IN ENGINEERING DESIGN
A.E. Rodgers, et al., New York, McGraw-Hill Book Co., Inc., 1960, 459 p.

. . . emphasis is on analog computer applications . . . a brief introduction to analog computers and a review of engineering mathematics.

ANALOGUE COMPUTATION TECHNIQUES AND COMPONENTS
R.W. Williams, New York, Academic Press Inc., 1961, 271 p.

. . . used in aircraft flight simulators. . . . emphasis is upon components, their design and accuracy. Also, more than the usual attention is given to ac amplifiers and resolvers as opposed to their dc counterparts. . . .

PROCESSING OF RANDOMLY FLUCTUATING DATA BY ANALOG ANALYSIS METHODS
C.H. Linden, National Aero-and Astronautical Research Inst. Amsterdam (Netherlands), March 1962, 70 p., 28 refs., N63-21255.

. . . A number of analog data reduction possibilities for random type signals are reviewed with respect to the determination of amplitude probability distributions, power spectrum, and cross power spectrum. A number of computation schemes and equipment required are discussed. Error sources and accuracy aspects are considered in some detail.

SPECIAL PURPOSE ANALYSIS TECHNIQUES
R. Archbald, et al., New York Univ., N.Y., Coll. of Engineering, Quarterly rept. no. 6, 6 April-5 July 1963, 5 July 1963, 92 p., AD 422 533.

The operation of the computer analyzer in compiling and maintaining a file of signals based on signal frequency and average prf has been demonstrated. Signal frequency, prf, amplitude, antenna pattern and transmitting antenna scan rate are permanently recorded for an operator as they are measured or calculated. The description is given of circuits for measuring peak pulse width and for improving the threshold of the signal presence circuit. . . .

GRAPHICAL DATA PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION
A.E. Brain, Stanford Research Inst., Menlo Park, Calif., Final rept. 1 April 1960-31 May 1963, Rept. no. 12, June 1963, 43 p., AD 417 787.

. . . machine for categorizing graphical data from maps, charts and aerial photographs. . . .

APPLICATION STUDIES OF COMBINED ANALOG-DIGITAL-COMPUTATION TECHNIQUES
F.B. Hills, Electronic Systems Lab., Mass. Inst. of Tech., Cambridge, AFCRL 63 72, Feb. 1963, 66 p., AD 404 179.

The concept of pulsed-analog computation in which high-speed, time-shared analog computing elements operate under the control of a digital computer is described. . . . computational tasks . . . (1) the solution of partial differential equations . . . (2) speech synthesis . . . (3) digital computer cathode-ray tube display — here the studies indicated that a fairly simple pulsed-analog computer can remove from the digital computer the time-consuming task of generating displays on the line drawing type and perform other tasks.

AUTOMATIC RADIO ENGINEERING SYSTEMS (In Russian)
B.K. Krivitskiy, Gosenergoizdat, Moscow Lengingrad, 1963, 664 p.

. . . a study is made of the main automatic systems employed in modern radio-engineering devices, such as systems for determining the direction of arrival of radio waves, auto-oscillator frequency control, the determination of the time position of pulses and amplification control. . . .

SOME OPTIMUM PROCESSORS FOR MODERN COMMUNICATIONS AND CONTROL APPLICATIONS
A.H. Sepahban, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 768/792, 17 refs.

. . . examples reviewed include a DDA (digital differential analyzer) processor for a time-optimal attitude control system; a z-transform processor for a high performance digital auto-pilot control; and a special purpose stored-program processor for message switching, signal detection and error correction coding for the communications subsystem of a modern command and control system.
Coding for signal detection by matched filter correlation of signal trains is compared with pure error correction coding. Digital processors for implementation of these two schemes are also compared.

DATA REDUCTION BY COHERENT OPTICAL SYSTEMS
A. Vanderlugt, et al., Institute of Science and Tech., U. of Michigan, Ann Arbor, Rept. no. 4594 40R, May 1964, 21 p., AD 432 863.

Coherent optical systems are useful in performing two major operations in data reduction: spectral analysis and linear filtering. . . .

SPACE SCIENCES OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 32/38.

Description of some of the equipment being used in the checkout of the Mariner C science subsystem . . . Count rate accumulator and ion chamber interval counter. . . . Real Time data translator. . . . Standard isolation box.

Related Publications:

VIDICON DATA HANDLING
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 3/4.

Examination of the Russian photographs of the back of the Moon indicates clearly that noise has been a severe handicap to their analysis. . . . Corrective techniques involve the use of analog equipment and include superposition of several photographs which tends to cancel out random noise.

Clean-up techniques which use dodging or the paint brush are rather haphazard. . . . Ranger and Surveyor will each produce large numbers of photographs which will require careful analysis. The techniques discussed in the following are new insofar as the digital computer has not previously been used to substitute for analog corrections of photographic materials. . . . Application of the computer to remove noise by comparing each line to its neighbors and watching for unusual events. . . . It should be possible to store three complete pictures of the RA-3 type in the computer at one time.

STATISTICAL INSTRUMENTATION STUDY
A.W. Crooke, et al., Litton Systems, Inc., Waltham, Mass. Final rept., RADC TDR63 136, 14 March 1963, 84 p., AD 405 925.

. . . techniques for estimating n-th order statistics of signals . . . including curve fitting methods . . . and success counting methods . . . a breadboard model . . . device will calculate fourth (and lower) order joint and conditional probability density functions and distribution functions for signals with bandwidth less than 10 Kcps . . .

Section 3A.51

3A.510: Systems Theory of Analog and Hybrid Processors

Included: Time frequency duality; Theory of analog computation; Continuous regression techniques; APACHE analog computation technique; Digital programming of analog computers; Error theory of analog computers; Frequency domain sampling methods; Pattern separation by convex programming; Identification problems in communications systems; Dynamic programming in analog computation.

Not Included: Uncertainty principle (1); Pattern recognition methods (2).

Cross References: Theoretical fundamentals of numerical computation methods (3A.116).

Principal Publications:

THEORECTICAL CONSIDERATION OF COMPUTING ERRORS OF A SLOW TYPE ELECTRONIC ANALOG COMPUTER
T. Miura, et al., IRE Trans. Electronic Comp., vol. EC-7, no. 4, Dec. 1958, p. 306/312.

When solving differential equations using analog computers, there are two causes of errors: one results from the integrators and the other results from the coefficient setting elements. . . . formulating a generalized and practical equation developed from conventional formulas.

GENERALIZED INTEGRATION OF THE ANALOG COMPUTER
G.A. Bekey, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 210/217.

One of the major limitations of the electronic analog computer is its inability to perform directly an integration with respect to a dependent variable. This paper reviews the usual method of overcoming this limitation, describes the results on an attempt to use Pade time-delay units in generalized integration, and presents the development of a new analog integrator based on a simple numerical integration formula. The integrator can be instrumented using standard analog computer components.

TIME MULTIPLEXING AS APPLIED TO ANALOG COMPUTATION
E. Rawdin, IRE Trans. Electronic, Comp., vol. EC-8, no. 1, March 1959, p. 42/47.

. . . can perform a common dynamic operation upon several sets of inputs utilizing equipment for one dynamic operation. . . . particularly useful to reduce the number of components required when implementing problems in a simulation laboratory.

ANALOG REPRESENTATION OF POISSON'S EQUATION IN TWO DIMENSIONS
R.J. Martin, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 490/496.

A new analog device, called a Poisson cell, has been developed which aids in obtaining solutions to either Laplace's equation or Poisson's equation. The cell may be used to simulate such potentials as electric potential, magnetic potential, gravitational potential, and the velocity potential of irrotational flow; it has applications in the fields of hydrodynamics, heat conduction, and aerodynamics. . . . incorporation of the cell into either an analog computer system or a combined analog-digital computer system.

SOLVING INTEGRAL EQUATIONS ON A REPETITIVE DIFFERENTIAL ANALYZER
R. Tomovic, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 503/506.

Results presented in this work show that practical solution of integral equations is possible using a repetitive differential analyzer of convenient design.

A METHOD FOR EVALUATION STIELTJES INTEGRALS ON THE ANALOG COMPUTER
T. C. Anderson, IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 552/555.

. . . The particular class of integrator functions considered consists of those functions of bounded variation with a finite number of jump discontinuities. The desired results are achieved through the use of analog logic and memory circuits and an example given showing an application of the method.

APACHE-A BREAKTHROUGH IN ANALOG COMPUTING
C. Green, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 699/706.

. . . APACHE (Analog Programming And Checking) system for the production of analog computer programs using a digital computer . . . language which has been formulated for the writing of analog problems is discussed and its rules are set out in the Appendix, while the processes involved in the utilization of the program are described and illustrated by example of the listing of the digital computer input and output for a range of equation types. . . .

AN ANALOG COMPUTER REALIZATION OF THE EUCLIDEAN TOOLS
R. E. Keller, IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 564/570.

The compass and straightedge of Euclidean geometry offer many computational possibilities. Their analog computer realization as described here was developed for the study of the kinematics of machinery, but may be useful in several other areas.

CONTINUOUS REGRESSION TECHNIQUES USING ANALOG COMPUTERS
A. I. Rubin, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 691/699.

It is shown in this paper how a straightforward solution of the regression problem can be obtained for continuous variables on a general-purpose analog computer. The linear case (least squares straight line) is thoroughly described. A specific nonlinear problem, that of estimating the parameters of a missile trajectory, is also described.

DELAY OF TIME FUNCTIONS BY MEANS OF FREQUENCY DOMAIN SAMPLING
W. W. Wierwille, Commun. and Electronics, vol. 80, no. 59, March 1962, p. 63/65.

. . . applicable when the delay time is greater than the waveform duration. The method is particularly amenable to analog computer techniques, and no special equipment is required. . . .

DATA ACQUISITION AND REDUCTION, PHASE VI, PART II. FEASIBILITY STUDY FOR REDUCTION AND ANALYTIC APPROXIMATION OF DATA RECORDS
R. E. Beckett, Iowa State U., Iowa City, Rept. no. 8, 3 Sept. 1963, 16 p., AD 418 417.

DYNAMIC PROGRAMMING: A BIBLIOGRAPHY OF THEORY AND APPLICATION
R. Bellman, et al., RAND Corp., Santa Monica, Calif., Memo. no. RM3951PR, Feb. 1964, 145 p., AD 429 915.

. . . a mathematical theory of multistage decision processes. . . . provides a valuable tool for the investigation of many challenging problems in such diverse fields as economics, engineering, systems analysis, and biomedical research. . . . helpful in all phases of problem solving-recognition, formulation, analysis, computation, and reformulation . . .

TIME-FREQUENCY DUALITY
P. Bello, IEEE Trans. Inform. Th., vol. IT-10, no. 1, Jan. 1963, p. 18/33.

. . . applicable to a class of networks called communication-signal-processing networks. Such networks consist of an interconnection of basic elements such as filters, mixers, delay lines, etc. . . .

AN OUTLINE AND DISCUSSION OF THREE PROPOSED METHODS FOR THE DATA ANALYSIS OF RADAR RETURN PULSES
G. W. Evans, et al., Stanford Research Inst., Menlo Park, Calif., Memo rept. no. 5, Aug. 1963, 36 p., AD 418 089.

Extensions for the application of the covariance and power spectral density functions and the finite Fourier transform and conjugate transform are given. These extensions are proposed for the analysis of radar return pulses when more than one data sample may be extracted from each return pulse.

MEASUREMENT OF THE PHASE SHIFT (Correspondence)
H. Handler, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 324/325.

In analog computer circuitry, the need for accurate phase measurements often arises. Inverting amplifiers contribute significant phase shifts at frequencies well below the 3-db frequency. These phase shifts cause large errors in a problem solution.

DYNAMIC ACCURACY AND ERROR IN ANALOG COMPUTATION
P. A. Holst, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 313/316.

It is shown that a simple circle diagram can be developed which will readily convert the dynamic amplitude ratio and phase shift characteristics of analog computing units (or similar electronic devices) into the corresponding rms-error functions. These rms-error functions which directly conform with the static dc accuracy specifications generally used, can be plotted in a new diagram giving the operational error characteristics of the units.

OB IPTIMAL'NOM ISPOL'ZOVANII PROSTRANSTVENNO-VREMENNYKH SIGNALOV (Concerning the Optimum Utilization of Space-Time Signals) (In Russian)
A.A. Kuriksha, Radiotekhnika i Elektronika, vol. 8, April 1963, p. 552/563, A63-19875.

. . . problems of optimum detection, measurement of coordinates . . . recognition of objects, as they arise in data processing in time and space.

KORRELATIONS ELEKTRONIK (Correlation Electronics) (In German)
F.H. Lange, Berlin, Germany, Veb Verlag Technik Berlin, 1963, 355 p.

This book, the first edition of which appeared in 1959, is an attempt to combine in one volume an introduction to the theoretical principles and the description of a number of applications of electronic correlation techniques. The book is written for engineers rather than mathematicians, and provides an urgently needed bridge between theory and practice. . . . An extensive bibliography, up to 1961, is given at the end. . . .

SOME RELATIONS BETWEEN DIGITIZING PARAMETERS AND CALCULATED STATISTICS OF A WAVEFORM
R. McAulay, Illinois Univ., Engineering Experiment Station, Urbana, Rept. nos. TR 18, TR1, 15 Aug. 1963, 35 p., AD 419 905.

. . . to investigate the effect which the analog-to-digital converter has in perturbing the values of certain statistics from their true values. . . . the analog of the actual sampling and quantizing process is developed as a computer program. This program can then be used to operate on the mathematical analog of the waveform under consideration to produce a new set of data points which represents the quantized amplitudes at successive sample times. Using these data the sample statistics are calculated. . . the mathematical expression for the incoming waveform. . . .

A FUNDAMENTAL ERROR THEORY FOR ANALOG COMPUTERS
D.J. Nelson, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Oct. 1963, p. 541/550.

The material presented here allows a fairly thorough analysis of deterministic errors in continuous systems. The methods outlined in other papers using sampled-data techniques permit the extension of this theory to include discrete systems such as DAA's and digital computers when used for solving differential equations using operational techniques.

PATTERN SEPARATION BY CONVEX PROGRAMMING
J.B. Rosen, Applied Mathematics and Statistics Labs., Stanford U., Calif., Technical rept. no. 30, 28 June 1963, 20 p., AD 416 795.

. . . can be formulated and solved as a convex programming problem, i.e., the minimization of a convex function subject to linear constraints . . . Very efficient computer methods have been developed for such programming problems and can be used to advantage for the pattern recognition problem.

AUTOMATIC DIGITAL PROGRAMMING OF ANALOG COMPUTERS
M. L. Stein, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 100/111.

A digital technique for manipulating symbols defining a mathematical expression is introduced and it is shown how this technique can be applied so that a digital computer can automatically compile an analog computer program directly from a mathematical description of the probelm to be solved.

IDENTIFICATION PROBLEMS IN COMMUNICATION AND CONTROL SYSTEMS
L.A. Zadeh, et al., Princeton U., N.J., March 1963, 231 p., AD 416 359.

. . . The aim of a conference was to consider problems underlying the areas of communication and control theory which are connected with the identification of signals and systems . . . mathematical forms of such representation to the models of physical systems.

Related Publications:

THE EFFECT OF MIXING TWO NOISY SIGNALS
N.A. Huttly, Marconi Rev. 4th Qtr., vol. 23, 1960, p.153/169.

Each signal is taken to be a sine wave with random noise. The signals are multiplied together and the product passed through a bandpass filter with a given impulse response. . . . Approximate solutions are given for the output signal-to-noise ratio when certain assumptions can be made about the bandwidths and the beat note frequency. . . .

A MACHINE MODEL OF RECALL
M.E. Stevens, Proc. Internat. Conf. Inform. Processing, June 1960, p. 309/315.

. . . consists of an initial vocubulary of terms, (nouns, adjectives, and proper names) and stored records of certain of their semantic and logical interrelationships, together with routines for various operations upon the machine's store of "knowledge" as available at any given time.

THE APPLICATION OF INVERSE CONVOLUTION TECHNIQUES TO IMPROVE SIGNAL RESPONSE OF RECORDED GEOPHYSICAL DATA
C.F. George, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2313/2319.

. . . process of restoring signal resolution to data recorded from a sluggish measuring device may be accomplished by appropriate mathematical operations on the data using a large digital computer. Smoothing techniques may be applied in the transform domain to derive an inverse convolver to be used in real space. . . .

ANALOG SIMULATION OF DIGITAL COMPUTER PROGRAMS
R. Saucedo, et al., Commun. and Electronics, vol. 80, no. 58, Jan. 1962, p. 703/709.

. . . to reduce the concept of a digital computer program to an analogous sampled-data control system, which can then be studied and analyzed by established theories and simulated on an analog computer. . . .

SEISMOLOGICAL APPLICATIONS OF ORTHOGONAL FUNCTION EXPANSIONS
Data Analysis and Technique Development Center, United Electrodynamics, Inc., Alexandria, Va., Semi-annual technical summary rept., Rept. no. 8, 20 Sept. 1963, lv., AD 418 150.

Section 3A.52

3A.520: Analog Function Units and Analyzers

Included: Analog function generators; Hybrid function generators; Analog signal conversion units; Analog spectrum analyzers; Linear differential analyzers; Pulse-burst generator; Waveform synthesizers; Repetitive differential analyzer; Linear segment function generator; Hybrid PR noise generator.

Not Included: Modulation nethods (1); Noise generators.

Cross References: Digital function generators (3A.420); Television scan conversion (3A.548).

Principal Publications:

AN ANALYSIS OF CERTAIN ERRORS IN ELECTRONIC DIFFERENTIAL ANALYZERS . . . 2. CAPACITOR DIELECTRIC ABSORPTION
P. C. Dow, Jr., IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 17/22.

. . . the feedback capacitors used in the integrators of a differential analyzer cannot be considered ideal, but their capacitance must be considered a variable. Methods of representing the complex capacitance are discussed and a model is selected which is conveniently suited to the analysis. . . .

COMPUTING AND ERROR MATRICES IN LINEAR DIFFERENTIAL ANALYZERS. . .
A. Nathan, IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 32/33.

. . . Matrix formulation permits the compact analysis of a very general computing scheme based on operational amplifiers. The computer solves an equation in which a computing matrix and an error matrix can be distinguished. Programming and a differential equation consists of writing it in an appropriate matrix form. The computing setup is in immediate mutual correspondence with the computing matrix. The error matrix can be written down by inspection.

NEW APPLICATIONS OF AN ELECTRONIC FUNCTION GENERATOR
R. Tomovich, IRE Trans. Electronic Comp., vol. EC-7, no. 1, March 1958, p. 48/51.

THE USE OF A REPETITIVE DIFFERENTIAL ANALYZER FOR FINDING ROOTS OF POLYNOMIAL EQUATIONS
P. Madich, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 182/185.

. . . describes a procedure for obtaining real and complex roots of algebraic equations with real or complex coefficients by the use of a repetitive differential analyzer. The procedure requires only operational amplifiers and ganged linear potentiometers. . . . The procedure is not iterative.

SOLVING INTEGRAL EQUATIONS ON A REPETITIVE DIFFERENTIAL ANALYZER
R. Tomovic, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 503/506.

. . . Results presented in this work show that practical solution of integral equations is possible using a repetitive differential analyzer of convenient design.

WAVE GENERATION AND SHAPING
L. Strauss, New York, McGraw-Hill Book Co., Inc., 1961, 535 p.

. . . use of piecewise linear circuit techniques as an analytical tool and through concentration on the mode of operation of active elements rather than on specific devices and their characteristics.

EVALUATION OF TWO MODIFIED TELETYPE 28 ASR FORMAT GENERATORS
J. F. Akers, et al., Federal Aviation Agency, Atlantic City, N. J., final rept., July 1962, lv., AD 297 910.

AN AUTOMATIC SPEECH FORMANT TRACKING FILTER
G. A. Hellwarth, Michigan U., Ann Arbor, Rept. no. 10, May 1962, 123 p., incl. illus., AD 282 147.

. . . a continuously tuned, automatic tracking filter system is proposed which locates these spectral maxima of speech signals through an application of automatic frequency control techniques. . . . The problem of constructing a complete speech analysis system utilizing tracking filters is discussed.

SPECTRA AND ANALYSIS (In Russian)
A. A. Kharkevich, Moscow, Fizmatgiz, 1962, 236 p.

. . . deals with a selection of spectral representations used in the theory of oscillations, acoustics, and radio engineering. . .

ACCURACY IMPROVEMENTS OF THE TAPPED-POTENTIOMETER FUNCTION GENERATORS
N. Parczanovic, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 63/66.

. . . a procedure for correct calculation of the resistance of the potentiometer function generator, including the load resistance of the generator. The possibility of generating the function by taking inequidistant values of the independent variable is also described. . .

LINEAR-SEGMENT FUNCTION GENERATOR
H. Schmid, IRE Trans. Electronic Comp., vol. EC-11, no. 6, Dec. 1962, p. 780/788.

A single-variable function generator, based on a pulse averaging method, accepts a width-modulated pulse input. The clock generator accuracy determines the precision with which this device can produce a linear-segment curve. . . .

. . . device can multiply the single-variable function by a second input variable at no loss of accuracy and with no additional circuitry.

AN INFINITE-RESOLUTION FUNCTION GENERATOR
P. H. Wendland, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 26/30.

An electro-optical device is described which provides a continuously-variable dc electrical signal in response to a shaft rotation. The elimination of a mechanical contact provides low torque, long life, and high speed operation. Shaping of the thin film resistance track associated with this device produces an interesting function generator.

A HYBRID ANALOG-DIGITAL PSEUDO-RANDOM NOISE GENERATOR
R. L. T. Hampton, Analog-Hybrid Computer Lab., Arizona Univ., Tucson, Jan. 1964, 45 p., AD 434 556.

. . . intended to replace conventional random noise generators in analog and hybrid computer simulating. . . It is capable of producing four essentially uncorrelated binary outputs from a single 25-state shift-register. . . .

HYBRID ANALOG-DIGITAL RANDOM-NOISE GENERATION
R. Hampton, et al., Arizona U., Tucson, Memo. no. 71, 1963, 3 p., AD 416 387.

Random-noise generators for random-process and statistical studies with analog and hybrid analog-digital computer should produce noise signals whose amplitude distribution, d-c unbalance, spectrum, and RMS level is specified within the computer-accuracy limits (0.1 to 0.5 per cent). . .

HYBRID ANALOG-DIGITAL RANDOM-NOISE GENERATION (Correspondence)
R. L. Hampton, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 412/413.

. . . the noise must be free from periodic components; noise samples must be uncorrelated for delays exceeding, say, one thousandth to one ten thousandth of a typical computer run.

GAUSSIAN-FILTER SPECTRUM ANALYZER
C. M. Harris, et al., J. Acoust. Soc. Amer., vol. 35, April 1963, p. 447/450, A63-19857.

Description of a real-time audio-frequency spectrum analyzer which consists of a bank of 54 contiguous band-pass filters of the Gaussian type. . . . a single output, which is a function of the power spectrum. . . made available for visual display and/or computer processing.

AIRBORNE VIBRATION SPECTRUM ANALYSIS: SOME TECHNIQUES AND LIMITATIONS
D. N. Keast, et al., In Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C., (Papers from) 31st Symp. on Shock, Vibration and Assoc. Environments —Pt. III, Phoenix, Ariz., Oct. 1-4, 1962, April 1963, p. 150/166, 12 refs., N63-16088.

THE 507 PULSE-BURST GENERATOR
R. T. Lee, Stanford Electronics Labs., Stanford U., Calif., Final rept., June 1961-June 1962, Technical rept. no. 507 SEL63 015, Feb. 1963, 38 p., AD 414 195.

. . . designed for use as a trigger source for laboratory pulse and rf generators. . . .

A COHERENT FREQUENCY WAVEFORM SYNTHESIZER (Correspondence)
F. E. Nathanson, et al., Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1773/1774.

. . . the equipment can be used as a waveform synthesizer, whereby a comb of coherent spectral components can be individually varied in amplitude and phase to determine the effects of such variation on the waveform. . . .

REAL-TIME ANALYSIS OF RANDOM VIBRATION POWER DENSITY SPECTRA
P. T. Schoenemann, In Defense Dept. Office of the Director of Defense Res. and Eng., Wash., D. C. (Papers from) 31st Symp. on Shock, Vibration and Assoc. Environments—Pt. III, Phoenix, Ariz., Oct. 1-4, 1962, April 1963, p. 232/239, 3 refs., N63-16094.

. . . uses a multiple-filter spectrum analyzer operation in real time, that is capable of providing power density spectra. Fourier analysis, and a bandpass filter analysis. . . .

A SYSTEMATIC APPROACH TO THE REALIZATION OF NONLINEAR OPERATIONS
M. C. Swiontek, Stanford Electronics Labs., Stanford U., Calif., TR1614; SEL63 023, April 1963, 86 p., AD 406 728.

. . . A systematic approach to the realization of the nonlinear operations of root extraction, exponentiation, reciprocation, division, multiplication, and logarithmic and antilogarithmic conversion is formulated on the basis of a nonlinear method of signal classification. . . The bandwidth expansion involved in subjecting a time-varying signal to an amplitude nonlinearity is developed. The results of this spectrum analysis are general in form and may be adapted to any nonlinear operation whose output can be written in a power series.

AN INTERPOLATION WAVEFORM GENERATOR FOR USE IN HYBRID COMPUTING SYSTEM
J. V. Wait, Arizona U., Tucson, Memo. no. 64, AFOSR 5180, 11 Feb. 1963, 6 p., AD 416 386.

. . . a precision saw tooth generator for use in generating interpolation waveforms for use in hybrid (parallel analog-digital) differential analyzer systems. The circuit generates positive and negative ramps, which have an initial value of zero and a final value of 10 volts. . . is nominally 1250 microseconds . . . The resetting time. . . is about 25 microseconds. . .

A METHOD OF GENERATING FUNCTIONS OF SEVERAL VARIABLES USING ANALOG DIODE LOGIC
R. H. Wilkinson, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 112/129.

. . . The circuit is formed of two cascaded sections: the first, using resistive networks, generates voltages representing each of the faces of the polyhedron; the second section, using analog diode logic, selects the appropriate voltage as the output.

RESEARCH ON VIDICON DISCRIMINATION TECHNIQUES
Aerojet General Corp., Azusa, Calif., Rept. no. 2610, June 1963, 34 p., AD 416 390.

. . . feasibility study of the general use of vidicons for discrimination are. . . applicable to satellite systems for missile-detection, namely: Two-color Discriminator for comparing relative radiance in two different spectral regions; Point Target Indicator which selects by object size; and a Spectrum Analyzer which recognizes certain spectral shapes.

INFRARED DATA PROCESSOR
ITT Federal Labs., Nutley, N. J. Final rept., Dec. 1961-March 1963, ASD TDR63 321, May 1963, 29 p., AD 411 111.

. . . capable of digitizing the X and Y coordinates of the infrared spectra to drive a card punch which records spectrum absorbance at successive wave numbers. . . The processor has the facility of sampling one, two or four equispaced samples per wave number. . .

Related Publications:

A TRANSISTORIZED FREQUENCY SYNTHESIZER
G. Husson, et al., J. Brit. Instn. Radio Engrs., vol. 21, no. 4, April 1961, p. 347/350.

The synthesizer provides 30,000 discrete frequencies between 2-32 Mc/s in steps of 1 kc/s with the stability of the driving frequency standard, using the arithmetic processes of addition, subtraction, multiplication and division, with the most economical use of a set of readily available basic numbers. Use is made of the phase-locked loop principle. . . .

THE BALANCED MODULATOR AS A CORRELATOR FOR RANDOM SIGNALS (Correspondence)
W. P. Birkemeier, et al., IRE Trans. Circuit Theory, vol. CT-9, no. 4, Dec. 1962, p. 417/419.

. . . wish to show that a similar correlation technique is afforded by the balanced modulator and, further, that the output signal-to-noise ratio is equivalent to that obtained with a pure multiplier operating on the undistorted signals.

RESTORATION OF TIME FUNCTIONS DISTORTED BY TRANSDUCERS DESCRIBED BY DIFFERENTIAL EQUATIONS
H. H. Grote, Army Electronics Research and Development Agency, Fort Monmouth, N. J., March 1963, 15 p., AD 408 341.

. . . This method is especially suited for application on the analog computer.

THE REALIZATION OF GIANT RADIO TELESCOPES BY SYNTHESIS TECHNIQUES
A. Hewish, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 2, Feb. 1963, p. 225/231.

The basic theory and a brief account are given of the Aperture Synthesis Technique in which, by means of correlation techniques, the performance of a large aerial array may be reproduced by a combination of fixed and movable aerials which occupy in succession all positions covered by the complete array. Practical considerations and some applications of aperture synthesis, in operation or projected at Cambridge, are described. . . .

ACCURATE LOG AND INVERSE-LOG FUNCTION GENERATING CIRCUITS: FOR USE IN DIGITAL VOCODER PITCH CHANNEL
L. V. Kriger, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 186, June 1963, 66 p., AD 413 479.

. . . novel synthesis technique, empirical in nature, is developed for diode-resistance function generation circuits attaining accuracies higher than theoretically possible by classic methods of piecewise-linear approximation. . . . Implementation of the dynamic models into the AFCRL digital vocoder and data processor, is described. . .

INTERPOLATING MULTIPLIERS AND RELATED INTERPOLATORS
A. Nathan, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1549/1554.

Piecewise-linear and nonlinear interpolators (PLI and NLI) for the generation of a function of one variable produce an output signal from two or more input signals which represent tangents to the function. . . .

ANALOG ANALYSES OF SEISOMOGRAMS RECORDED ON MAGNETIC TAPE
G. H. Sutton, et al., Lamont Geological Observatory, Palisades, N. Y., 1 May 1963, 25 p., AD 415 788.

. . . Plots of frequency versus time and of cumulative signal, in different frequency bands, versus time present seismic data in a form more convenient for certain studies than the conventional record.

REPRESENTATION AND ANALYSIS OF SIGNALS. PART XIV. TIME VARYING SYSTEMS WITH SEPARABLE SYSTEM FUNCTIONS
L. Weiss, Johns Hopkins U., School of Engineering, Baltimore, Md., 30 Jan. 1963, 94 p., AD 411 274.

. . . The realization of linear differential systems is discussed, and some "tricks" regarding manipulation of the position of function generators in an analog computer type realization (without changing the input-output relation) are presented. . .

Section 3A.53

3A.530: Analog Control and Computing Units

Including: Information processor for object recognition; Digital-analog pulse amplitude interpolation computer; Frequency transform computer; Algebraic equation solver; Isograph; Pulse position modulation analog computer; Correlation operation on analog computers; Pattern information processor (PIP); Real time analog-digital computation; Amplitude comparator.

Not Included: Pattern recognition (2).

Cross References: Functional units of analog computers (Sect. 3A.23); Digital correlators (3A.433).

Principal Publications:

FOURIER ANALYSIS BY A GENERAL PURPOSE ELECTRONIC ANALOGUE COMPUTER
N. S. Nagaraja, J. Inst. Telecommun. Eng., vol. 4, June 1958, p. 130/136.

A NOVEL TYPE OF ISOGRAPH (ALGEBRAIC EQUATION SOLVER)
P. V. Rao, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 97/103.

FREQUENCY-TO-PERIOD-TO-ANALOG COMPUTER FOR FLOWRATE MEASUREMENT
T. W. Berwin, IRE Trans. Electronic Comp., vol. EC-9, no. 1, March 1960, p. 62/71.

. . . a special purpose nonlinear analog computer which accepts an ac voltage of varying frequency, acts upon the period of each cycle, computes the inverse of the time period, e=1/T, and holds the information for the period of the next cycle. Thus, the output voltage is a level which is proportional to the input frequency f = 1/T computed once for every cycle.

A PULSE POSITION MODULATION ANALOG COMPUTER
E. V. Bohn, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 256/261.

. . . Variables are represented by the time interval between pulses. Utilizing a few basic components, it is possible to carry out the operations of addition, subtraction, multiplication and function generation to 0.1 per cent accuracy.

A DIGITAL-ANALOG PULSE AMPLITUDE INTERPOLATION COMPUTER
J. D. Schmidt, et al., Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 600/610.

. . . hybrid digital-analog system with the interpolation being performed by an analog circuit and the addition or subtraction being performed digitally. . . . gave an accuracy of 0.3% in this application and resulted in a considerable saving in circuit complexity over a straight digital or analog system. . . .

AN AUTOMATIC ANALOGUE COMPUTER FOR MISSILE-HOMING INVESTIGATIONS
J. G. Thomason, Trans. Instrument Tech., vol. 12, March 1960, p. 16/21.

. . . operates and resets its parameters in response to an input program punched on paper tape. . . encodes its results and punches them on an output tape. . . The computer was developed to eliminate the routine work necessary in computer investigation of guided missile system performance and the tedious analysis of the computer results.

TWO-LEVEL CORRELATION ON AN ANALOG COMPUTER
C. L. Becker, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 752/758.

. . . It has been known for some time that an approximation correlation analysis of a random process can be performed using quantized values of signal. The simplest form possible is a two-level correlation, wherein merely the polarities of the process at two sampling times are compared.

RECEIVER OSCILLATOR SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 55/57.

An automatic local oscillator tuning system for a non-synchronous receiver is described. . . . Automatic local oscillator tuning with satellite ephemeris data will simplify the frequency acquisition problem for an accelerating target. In addition, automatic local oscillator tuning with ephemeris data during closed loop operation can provide a possible method of operating with reduced bandwidth.

. . . accomplished by comparing the predicted doppler signal with the UHF doppler signal and using the resultant error to control a VCO in a servo loop. . . . The ultimate tracking accuracy of a digitally controlled oscillator sampling servosystem is dependent on the spectral width of the oscillator signal. . . . The digital tracking system now being developed is shown in Fig. 7. This system is similar to that developed for the Venus experiment in that rate and error signals are derived from mechanically driven potentiometers.

CORRECTION TO "TWO-LEVEL CORRELATION OF AN ANALOG COMPUTER" (Correspondence)
C. L. Becker, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 578/579.

REAL-TIME ANALOG-DIGITAL COMPUTATION
M. E. Connelly, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 31/41.

. . . A hybrid configuration is suggested consisting of a basic digital computer and peripheral, high-speed analog elements used on a time-shared basis under the control of the digital program. . . .

A NEW METHOD TO COMPUTE CORRELATION FUNCTIONS
P. Jespers, et al., IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. S106/107.

. . . extends the method of the computation of the polarity correlation function. The polarities of both signals to be correlated are determined at given instants separated to τ seconds, each one with respect to a varying reference level. Both these levels can occupy any possible value between limits located symmetrically around zero. . .

HYSTERESIS-FREE TUNNEL-DIODE AMPLITUDE COMPARATOR (Correspondence)
R. A. Kaenel, IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 286/287.

. . . circuit discussed is remarkably simple and exhibits a high degree of thermal stability, besides performing the comparator function at a high switching speed typical of tunnel diodes.

CONSTANT CURRENT SOURCE FOR ANALOG COMPUTER USE (Correspondence)
R. W. Thorpe, IRE Trans. Electronic Comp., vol. EC-11, no. 6, Dec. 1962, p. 792/793.

. . . permits the load to be grounded directly or returned to any arbitrary point. Necessary conditions are derived for infinite or negative output impedance, and for stability under these potentially unstable operating conditions.

MULTIPLE INTEGRALS ON A NON-REPETITIVE ANALOG COMPUTER
A. Hausner, Proc. Spring. Joint Comp. Conf., May 1963, p. 205/212.

. . . presents a technique for generating improved approximations to multiple integrals. The derivation of the approximating equations for solution on the analog computer is closely reasoned and is well worth careful examination since this type of reasoning is a powerful technique in itself. The method employed to evaluate the iterated multiple integral is to integrate over a distorted path.

ARITHMETIC OPERATIONS OF A FREQUENCY TRANSFORM COMPUTER
H. W. Koester, Air Force Inst. of Tech., School of Logistics, Wright-Patterson AFB, Ohio, Aug. 1963, 91 p., AD 420 014.

A hybrid computer which has digital input-output and an analog arithmetic unit is described. Digital inputs are converted into composite waveforms which appear as numerical quantities, thereby making arithmetic operations possible by direct manipulation of the waveform. . . .

ANALOG/HYBRID STORAGE AND PULSE MODULATION
G. A. Korn, Arizona U., Tucson, Memo. no. 67, 30 March 1963, 6 p., AD 416 389.

. . . While function storage for the duration of a single computer run is already useful for many iterative computation schemes, such as the solution of integral equations, function storage for an indefinite time period would be substantially more desirable and would, for instance, permit table lookup and storage of functions for use in later computation cycles.

DEVELOPMENT OF AN INTEGRATED CORRELATION SYSTEM
B. Leven, Marine Engineering Lab., Annapolis, Md., MEL A 68 102A, 17 March 1964, 12 p., AD 432 474.

. . . to provide the data necessary to discern and identify noise propagation paths in mechanical structures. . .

FEATURE WORD CONSTRUCTION FOR USE WITH PATTERN RECOGNITION ALGORITHMS: AN EXPERIMENTAL STUDY
R. L. Mattson, et al., J. Assoc. Comp. Machinery, vol. 10, Oct. 1963, p. 458/477, 15 refs., A64-11312.

. . . The effect of coding on recognition is. . . investigated using the Pattern Information Processor (PIP) proposed by Healy to process the data.

A HYBRID/ANALOG-DIGITAL ONE-PARAMETER OPTIMIZER
B. A. Mitchell, Arizona U., Tucson, Memo. no. 69, 8 April 1963, 15 p., AD 416 388.

A HYBRID ANALOG-DIGITAL PARAMETER OPTIMIZER FOR ASTRAC II
B. A. Mitchell, Arizona Univ., Tucson, Memo. no. ACL90, 16 Jan. 1964, AD 434 559.

A new automatic multi-parameter optimizer for iterative differential analyzers employs sequential random parameter perturbation. . . . Binary counters operate simple digital-to-analog converters to implement parameter storage, multiplication, and step-size changes. All-digital logic yields different types of random perturbations, viz. simple random walk, random walk with reflecting or absorbing barriers, and various types of correlation over successive perturbations. . . .

AN ELEMENTARY INFORMATION PROCESSOR FOR OBJECT RECOGNITION
J. C. Pennypacker, Systems Research Center, Case Inst. of Tech., Cleveland, Ohio, Rept. no. SRC31163 1, May 1963, 105 p., AD 413 370.

. . . processor, which consists of a series of computer flow charts, is described. The processor is capable of forming conceptions of known and new concepts and is capable of processing information relevant to these concepts. In addition, the processor is capable of elementary learning.

AN OPERATION HYBRID COMPUTING SYSTEM PROVIDES ANALOG-TYPE COMPUTATION WITH DIGITAL ELEMENTS
H. Schmid, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 715/732.

. . . employs several computing elements to solve algebraic, transcendental and integro-differential equations operational-digital.

Information between the different computing elements is carried in the form of pulse-width signals. Each computing element employs only digital circuits, but in an analog fashion.

Related Publications:

THE ITERATIVE CONTROL SYSTEM FOR THE ELECTRONIC DIFFERENTIAL ANALYZER
M. C. Gilliland, IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 86/93.

. . . discussion. . . regarding new applications for the iterative differential analyzer. . . . Some comment is given regarding the limitations of the new computer and also its relationship to digital computers.

A BREAKTHROUGH IN ANALOG COMPUTING
C. Green, et al., IRE Trans. Electronic Comp., vol. EC-11, Oct. 1962, p. 699/706.

This presentation of the APACHE (Analog Programming And CHEcking) digital computer program concerns itself with the significance of automatic analog programming and with the language problem. . . .

RESOLUTION AUTOMATIQUE DES EQUATIONS IMPLICITES PAR LA TECHNIQUE DE CALCUL ANALOGIQUE "ANALAC" (Automatic Solution of Implicit Equations by the Analog Computation Technique "ANALAC") (In French)
E. Honore, et al., Ann. Radioelect., vol. 17, no. 69, July 1962, p. 171/175.

On account of the properties of association and reversibility of its constituent parts, the ANALAC analogue technique is eminently suitable for the automatic solution of implicit equations. With no action on the part of the operator the control loops of the different variables are automatically decoupled. It is as though each variable were isolated; in other words, the "variables are separated."

RESOLUTION AUTOMATIQUE PAR LA TECHNIQUE DE CALCUL "ANALAC" DES EQUATIONS DIFFERENTIELLES IMPLICITES
(Automatic Solutions of Implicit Differential Equations by the "ANALAC" Computing Technique) (In French)
E. Honore, et al., Ann. Radioelect., vol. 17, no. 70, Oct. 1962, p. 333/338.

It was seen in a previous article that the Analac technique could give an automatic solution of systems of implicit equations, whether static or dynamic. In the present article an extension of this possibility is given for the case of implicit differential equations. In certain cases arrangements made for static equations will suffice and the method used follows quite naturally from the preceding methods. But in other cases it is necessary to utilize a block which does not correspond to a usual mathematical symbol designated "reversible integrator.

A TIME-DIVISION ANALOGUE MULTIPLIER FOR CORRELATION MEASUREMENTS AND MIXING AT FREQUENCIES UP TO 100 KILOCYCLES PER SECOND
R. F. Johnson, National Physical Lab., Great Britain, NPL AERO rept. no. 1030, 10 Aug. 1962, 15 p., AD 401 661

For processing noise and turbulence signals . . .

THE EFFECTS OF NOISE THROUGH AN ANALOG INTEGRATOR WHICH INTEGRATES WITH RESPECT TO AN ARBITRARY VARIABLE
P. R. Westlake, IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 3, Sept. 1962, p. 151/158.

. . . to consider the effects of noise, both internal and external, on any possible computation control process. The external noises would arise in communication links, the drifts of gyros, the drifts of gyros, possible variations in external conditions, variations in amounts and rates of rocket burning, and other causes. . . . In the event that an incremental digit or analog computer is part of a control loop, a typical problem would be signal plus noise into an analog or digital integrator.

A PULSE MODULATOR THAT CAN BE USED AS AN AMPLIFIER, A MULTIPLIER, OR A DIVIDER
J. A. Rosenthal, IEEE Trans. Instrum. Measurement, vol. IM-12, Dec. 1963, p. 125/134, A64-17346.

. . . operates by continuously sampling the input signal. The output of the modulator is a pulse train whose frequency and pulse duration vary with the input signal. The modulator can respond instantaneously to a change in the input signal. It is capable of both proportional and on-off control and may be used as an amplifier, a multiplier, or a divider, or any combination of these three. . .

PARALLEL DIGITAL DELAY-LINE CORRELATOR (Correspondence)
H. J. Whitehouse, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 237/238.

. . . new parallel digital time-compression correlator built by the Naval Ordnance Test Station processes one unit of delay during each clock interval. . . Thus the parallel unit operating at the same clock rate as the serial unit has a speed advantage directly proportional to the sample size. . . .

Section 3A. 54
Converters Involving Analog Computations

3A. 542: Analog to Digital Converters

Included: A/D converters; Time coding analog to digital converters; Telemetry analog to digital information converter (TADIC); Voltage to digital converter; Squaring A/D converter.

Not Included: Theory of sampling and quantization (1); PCM modulation methods (2).

Cross References: Digital code converters (3A. 440).

Principal Publications:

ANALOG VOLTAGE-TO-DIGITAL CONVERTERS
T. V. Rehwoldt, Missile Div., Chrysler Corp., Detroit, Mich., Report on Field Artillery Guided Missile System, Redstone, Technical memo. no. AD-M28, 6 Dec. 1956, 11 p., incl. illus., AD 289 595.

A review of the voltage-to-digital converter field is presented. . . . theory of operation of typical converters . . . description of a commercial converter . . . recommendations for the most suitable converter for Chrysler Corporation Missile Operation use. . . .

A HIGH-SPEED, ELECTRONIC ANALOG-TO-DIGITAL ENCODER
R. C. Platzek, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 182/194.

. . . a high speed, semiconductor, bi-polar analog voltage encoder with fourteen bit capacity. The device accepts and continuously converts voltages which are static or varying at rates not exceeding 2500 volts per second. The output is a binary coded decimal equivalent of the input voltage presented for parallel readout. . . .

A HIGH-SPEED ANALOG TO DIGITAL CONVERTER
D. Savitt, IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 31/35.

. . . converts analog voltages to their corresponding parallel seven binary-digit representations at a 50-kc encoding rate. The encoder is capable of being time-shared by any number of 0-50-volt range inputs. . . . Either more precise conversions or higher encoding rates may be obtained at the expense of the other by cascading more or less of the identical one-digit encoder stages which constitute the analog to digital converter.

ELECTRONIC QUANTIZING DEVICES (REVIEW)
M. A. Aingorn, Radio Engng: Transl. of Radiotekhnika, vol. 15, no. 5, 1960, p. 56/69.

A classification of electronic quantizing devices is given. A study is made of the principles on which they work and their basic characteristics. . . .

ANALOG-TO-DIGITAL CONVERSION WITH THRESHOLD DETECTORS (Correspondence)
P. W. Cheney, IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 100/101.

The relationship between logical complexity and conversion time is derived for a generalized, cascade, analog-to-digital converter using threshold detectors for the digitizing operation.

A SQUARING ANALOG-DIGITAL CONVERTER (Correspondence)
J. R. Cox, Jr., IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 98/100.

In the analysis of signals utilizing digital techniques, it may be necessary to obtain the digital word equivalent to an analog voltage and, in addition, the square of this word. A frequently encountered example is the computation of the mean and variance of a sampled signal. The square can be obtained simultaneously with the analog-digital (AD) conversion by use of the following modification of the trial encoder method of AD conversion.

HIGH-SPEED ANALOG-TO-DIGITAL CONVERTERS UTILIZING TUNNEL DIODES
R. A. Kaenel, IRE Trans. Electronic Comp., vol. EC-10, no. 2, June 1961, p. 273/284, 55 refs.

Two analog-to-digital sequential converters have been devised which combine in one tunnel-diode pair per bit the functions of an amplitude discriminator and memory. In addition, one of the two schemes utilizes each tunnel-diode pair as a delay network. The conversion duration of one of these six-bit converters, which employs germanium 2N559 transistors and gallium arsenide 1N651 tunnel diodes, has been set to 1 μ sec. A comprehensive bibliography relating to tunnel-diode switching circuits is attached.

A HIGH-SPEED ANALOGUE TO DIGITAL CONVERTER
N. Winterbottom, et al., Electronic Engrg., March 1961, p. 144/149.

The encoder described has a relatively good performance with 8 bits per sample and 55,000 conversions per second. The encoding technique is classical; sequential weighting by means of an analog adding network, a comparator amplifier and a digital feedback network controlling the switches of the adder. Unusual is the mechanical, rotary, sampling switch, designed for low noise and minimum crosstalk.

DESCRIPTION AND MANUAL OF OPERATION FOR ANALOG TO DIGITAL CONVERTER
W. A. Bellmer, Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y., Research rept. no. PIBMRI 978-61, 29 Jan. 1962, 51 p., incl. illus., tables, AD 277 513.

In the study of radio station recognition from signal strength fading characteristics, it has been necessary to provide samples of the fading patterns in a form suitable for use by the IBM 650 computer.

AN ANALOG-TO-DIGITAL ENCODER EMPLOYING NEGATIVE RESISTANCE DEVICES
B. Rabinovici, et al., IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 435/441.

. . . A six-bit analog-to-digital (A/D) encoder for use in multiplexing a number of voice communication channels is described experimental results presented. . . . The encoding speed measured for an accuracy of 20 per cent of a step was 16 μ sec/character. . . . decoder was built to allow objective as well as subjective tests on the over-all system. A signal to quantizing noise of 6db/bit and 44.5 db over-all was measured with a 1100-cps sine wave at full load using a spectrum analyzer. . . .

SOLID STATE ANALOG-TO-DIGITAL CONVERTER
P. G. Sedlewicz, et al., Northwestern Technological Inst. Evanston, Ill., Quarterly progress rept. no. 1, May-July 1962, Memo. no. 369, July 1962, 30 p., incl. illus., refs., AD 283 377.

LOGARITHMIC ANALOG-TO-DIGITAL CONVERTERS
D. K. Willim, Electronic Design, vol. 10, Feb. 1962, p. 36/41.

A type of analog-to-digital converter which uses the logarithmic decay of the voltage on a capacitor is described. . . . The duration of the level is proportional to the logarithm of the ratio of the input to the reference level. . . . The converter is useful for simplified mechanization of multiplication, to produce logarithmic normalization and to produce a power ratio.

A HIGH-SPEED, AIRBORNE, VOLTAGE-TO-DIGITAL CONVERTER (Part 2)
D. W. Allen, et al., Royal Aircraft Establishment, Farnborough (Gt. Brit.), London, Ministry of Aviation, RAE-TN-SPACE-33, May 1963, 98 p., 14 refs., N63-19869.

. . . using a chopper corrected comparator amplifier to improve the long-term stability. . . .

HIGH-SPEED PCM ENCODER-DECODER
J. A. Arida, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 155/157.

The goal. . . . is to transmit wide-band information with the least amount of signal degradation. . . . In addition to the digital encoding-decoding devices described in this paper, the digital data transmission system contains a multiplexer, a demultiplexer, a communications link with a 100-megacycle bandwidth consisting of an amplitude modulator, a transmitting amplifier, transmitting and receiving antennas, a mixer, an i-f amplifier, and a demodulator. . . .

DEVELOPMENT AND FABRICATION OF A PROTOTYPE AIRBORNE AND GROUND ENCODING SYSTEM
C. Barbour, Towson Labs., Inc., Md., Final rept., 13 Jan. 1964, 21 p., AD 426 999.

. . . airborne analog-to-digital converter and a ground based analog to digital converter . . . Both units utilize charge transfer circuits . . . In the airborne converter, the serial train of pulses is converted into an NRZ format . . . In the ground based converter, the serial train of pulses is fed to a shift register, from which the digital output may be obtained whether in serial NRZ or in parallel form . . .

A TIME CODING ANALOG-TO-DIGITAL CONVERTER
B. T. Cronhjort, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1541/1549.

. . . using an exponential voltage sweep . . . The technique inherently offers the possibility of convenient automatic recalibration in order to compensate for long-term drift. Thus, the converter is particularly well suited for on-line use in automatic digital data reduction systems. . . .

A PRECISION LOGARITHMIC A/D CONVERTER
P. A. Hoffman, Proc. Nat. Telem. Conf., May 1963, no. 2-5.

SYNTHESIS OF OPTIMAL FILTERS FOR FEEDBACK QUANTIZATION SYSTEM
E. G. Kimme, et al., IEEE Internat. Conv. Rec., Pt. 2, vol. 11, March 1963, p. 16/26.

. . . One proposal for a baseband quantization system for narrow-band television signals incorporates linear predistortion and reconstruction, and a linear noise feedback loop around the quantizer. Using an additive noise model for the quantizer, a procedure is developed for synthesizing a predistortion filter, a reconstruction filter. . . and a feedback filter. . . for this system so as. . . through a rapidly converging iterative procedure on an IBM 7090 automatic computer. . . .

NANOSECOND ANALOG TO DIGITAL CONVERSION
W. Peil, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 794.

. . . a wide band (25 MC), six bit analog-to-digital converter. One of the more important applications of such equipment is in the communications link of a high resolution satellite reconnaissance system.

The realization of equipment with this capability is made possible by the use of a variety of components and techniques which have been introduced only recently . . . the unique properties of the tunnel diode with regard to speed, stability and noise performance . . . the generation of very narrow sampling pulses at substantial power levels and high repetition rates was performed by charge storage (snap) diodes . . . strip transmission line techniques, miniature components and transistor isolators . . .

Tests results . . . possibilities of extension of these techniques to equipment with still greater bandwidth capabilities . . . the ultimate limit of such an extension is imposed primarily by noise rather than switching speeds.

ANALOG-TO-DIGITAL CONVERSION WITH SUPERCONDUCTORS (Correspondence)
B. Rabinovici, Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 369/370.

A HIGH SPEED DATA HANDLING EQUIPMENT FOR UPPER ATMOSPHERE RESEARCH
R. C. Reed, et al., Electronic Engng., vol. 35, June 1963, p. 387/389, A63-23476.

. . . description of the Telemetry Analog to Digital Information Converter (TADIC). . . .

A PRECISION FLYING SPOT FILM DIGITIZER
J. A. G. Russell, California U., Livermore, Calif., Lawrence Radiation Lab., 13 Dec. 1963, 14 p., refs., N64-17291.

. . . measure locations of images on transparent film by automatically scanning an area on the film with a mechanically generated flying spot of light. These location measurements are directly transmitted to a digital computer for subsequent processing. The digital computer controls and monitors the digitizing equipment operations . . .

SOLID STATE ANALOG-TO-DIGITAL CONVERTER
P. G. Sedlewicz, et al., Aerial Measurements Lab., Northwestern U., Evanston, Ill., Quarterly progress rept. no. 3, Nov.-Dec. 1962, Memo no. 381, Jan. 1963, 27 p., AD 299 088.

AN UNUSUAL SERIAL RECIRCULATING ANALOG-TO-DIGITAL CONVERTER SUITABLE FOR AEROSPACE APPLICATIONS
B. K. Smith, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 82/89.

LOGICAL CIRCUITS FOR CONTROLLING THE ANGULAR POSITION OF AN EIGHT DIGIT GRAY CODED DISC
R. J. K, Splatt, Royal Aircraft Establishment, Farnborough (England), RAE Technical note no. IEE7, AD 420 383.

A laboratory constructed angular position servo and a follow-up servo employing an eight digit Gray coded disc are described. The circuits utilize transistors operating in switching mode throughout. . . .

SOLID STATE ANALOG-TO-DIGITAL CONVERTER AND ELECTRON AND HOLE INJECTION BY A METAL-DEPLETION LAYER CONTACT
V. J. White, et al., Aerial Measurements Lab., Northwestern U., Evanston, Ill., Final rept., Memo. no. 400, 30 Dec. 1963, 1v., AD 428 846.

. . . final report . . . feasibility of fabricating a solid-state analog-to-digital converter . . . based on the movement of the depletion region of a reverse biased p-n crystal of the silicon and the detection of this movement.

ANALOG-DIGITAL CONVERSION HANDBOOK
Maynard, Mass., Digital Equipment Corp., 1964, 73 p., A64-17167.

Comprehensive information . . . on digital-to-analog and analog-to-digital conversion. The handbook is intended for both beginners and experts. . . . diagrams . . . tabular summaries . . . performance characteristics . . .

Related Publications:

SOME RELATIONS BETWEEN DIGITIZING PARAMETERS AND CALCULATED STATISTICS OF A WAVEFORM
R. McAulay, U. of Illinois Engineering Experiment Station, Urbana, Technical rept no. 18, Technical rept no. 1, Rept. no. RRL208; 15 Aug. 1963, 36 p., AD 417 243.

3A. 548: Other Converters

Included: Digital-to-analog converters; Digital-to-angle converter; Binary-to-video data converter; Video scan converters.

Not Included: Television camera techniques; Deflection circuits.

Cross References: Digital code converters (3A.440); Electron beam storage devices (3A.263).

Principal Publications:

A HIGH-SPEED TRANSISTORIZED DIGITAL-TO-ANALOG DECODER
B. A. Antista, Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 776/788.

. . . accepts digital information in parallel, binary-coded decimal form. The output is bipolar d-c current at a constant source impedance.

THE APPLICATION OF DIGITAL ANGLE ENCODERS TO TARGET TRACKING SYSTEMS
G. H. Wayne, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 202/205.

DIGITIZING UNIT FOR A CHART RECORDER
J. L. Smith, Proc. Instn. Radio Engrs. Australia, vol. 23, no. 3, March 1962, p. 177/183.

. . . describes a digital output unit for a strip chart recorder using a shaft position digitizer. The recorder is a self balancing potentiometric device and the digitizing transducer is attached to the balancing motor shaft. The output is available in decimal and binary coded decimal form, quantized to 1000 parts. . . .

A MAGNETIC REVERSIBLE COUNTER WITH DIGITAL-TO-ANALOG CONVERSION PHYSICAL ELECTRONICS
L. M. Cohen, Lockheed Missiles and Space Co., Sunnyvale, Calif., Final Technical Report, LMSC-6-90-63-29, April 1963, 47 p., 8 refs., N63-15825, AD 403 867.

. . . describes a time-shared, two-channel magnetic counter and digital-to-analog converter. The counter is capable of performing unit addition and subtraction. . . . The logic operations were performed by time-shared diode gate circuits. The calculated worst-case error for the digital-to-analog conversion is $\pm$ 0.3 percent. . . .

A SCAN-CONVERSION TUBE UTILIZING FIBER-OPTICS PHOTON TRANSFER
R. J. Doyle, IEEE Trans. Electron Devices, vol. ED-10, Nov. 1963, p. 410/416, A64-11705.

. . . consists basically of a reading electron gun, a writing electron gun and an interjacent scan-conversion target. The targets consist of a fiber-optics disk coated on one side with a phosphor and on the other with a photoconductor; the reading gun is similar to the low velocity gun of a vidicon, and the writing gun is a high velocity cathode-ray tube gun. . . .

EVALUATION OF BALDWIN PIANO COMPANY SIZE 11 OPTICAL ANALOG-TO-DIGITAL SHAFT ENCODER
L. S. Garrett, Aeronautical Instruments Lab., Naval Air Development Center, Johnsville, Pa., NADC AI 6350, 19 July 1963, 20 p., AD 419 237.

New techniques using optical and solid state methods were to be investigated. . . . evaluating five optical encoders. . . . employ a 13 bit disk . . . using the gray code . . . can operate at a one megacycle bit rate. . . . significant advance in the state-of-the-art. . . .

DOUBLE-RECEPTION DISCRETE DATA OPTIMUM CONTINUOUS SIGNAL RECOVERY
J. C. Hung, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 241/253.

. . . This paper deals with the recovery of a continuous signal from received discrete data. Very often, two sets of discrete data, obtained independently, are available for the recovery of a continuous signal. The two sets of discrete data have, in general, different data-rates. . . . Optimum systems using both sets of discrete data are , in general, time-varying as opposed to the time-invariant property of the systems using only one set of discrete data, even though the signals and noise are stationary. . . . A procedure for the optimum recovery of a continuous signal using two sets of discrete input-data will be developed, and methods for evaluating the mean square-error will be shown. . . .

A DIODE DIGITAL-TO-ANALOG CONVERSION TECHNIQUE
J. Ihnat, Naval Research Lab., Washington, D. C., NRL rept.no. 5866, 30 Jan. 1963, incl. illus., tables, AD 297 390.

The transformation is approximate since errors are introduced during conversion. Various techniques have been developed to minimize these errors; the most popular ones are the weighted resistor method and the ladder arrangement.

The digital-to-analog conversion speed amounted to 20 microseconds for the case considered.

A DECODING "DIGIT-TO-ANGLE" CONVERTER WITH INTERMEDIATE CONVERSION
N. A. Smirnov, et al., Joint Publications Research Service, Washington, D. C., JPRS-21553; OTS-63-31989, Oct. 23, 1963, 17 p., refs., Transl. into English from Izv. Vysshikh Uchebn Zavedinii, Elektromekhan (Novocherkassk) no. 5, May 1963, p. 597/604, N64-10196.

. . . using standard components of alternating current tracking systems, as used aboard aircraft . . . decoding digit-to-angle converter that is recommended whenever linear or functional code conversion into a turning angle is required, without too much stress on cirtical precision . . .

LOGICAL CIRCUITS FOR CONTROLLING THE ANGULAR POSITION OF AN EIGHT DIGIT GRAY CODED DISC
R. J. K. Splatt, Royal Aircraft Establishment, Farnborough (England), RAE Technical note no. IEE7, May 1963, 24 p., AD 420 383.

A laboratory constructed angular position servo and a follow-up servo employing an eight digit Gray coded disc are described. The circuits utilize transistors operating in switching mode throughout. . . .

EVALUATION OF AN EXPERIMENTAL MODEL OF THE DIGITAL-TO-ANALOG CONVERTER SET AN/FYQ-12 (XN-1)
D. J. Theobald, Navy Electronics Lab., San Diego, Calif., NEL 1164, 19 April 1963, 24 p., AD 407 153.

. . . evaluated to determine its conformance to the design goals as set forth in the contract specifications. . . . evaluating the converter as part of a digital sweep and track position display system . . .

MULTI-SPEED RESOLVERS FOR ANALOG DIGITAL CONVERSION OF SHAFT ANGLES
H. E. Thomason, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala., 9 July 1963, 33 p., N64-11229.

BINARY-TO-VIDEO DATA CONVERTER
Hazeltine Technical Development Center, Inc., Indianapolis, Ind., Final rept., Rept. no. 6146, RADC TDR63 427, Feb. 1964, 44 p., AD 434 759.

Report on System 473L, . . . various techniques . . . for accepting binary information from a computer (or similar type of input) and producing a display on a TV raster. Information to be shown on the display included alpha-numerics, symbols, map data, and similar processed-data readout in the form used for command and control displays. . . .

Section 3A.55

3A.550: Semi-analog (Sampled) Pulse Processing Methods

Included: Electronic switching systems; Broadband switching systems; Time slot interchange system; Time division electronic exchanges; Electronic crosspoint PABX; Electronic switchboards; Resonance transfer method; PDM to digital encoder; Multi-channel pulse height analyzer; PAM to PWM conversion.

Not Included: Pulse communications methods (1).

Cross References: Switching theory (3A.120).

Principal Publications:

THE APPLICATION OF DIGITAL COMPUTER TECHNIQUES TO ELECTRONIC AUTOMATIC TELEPHONE SWITCHING SYSTEMS
D. K. Melvin, Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 593/605.

This paper describes the basic principles of crosspoint and time-division-multiplex electronic telephone switching systems with an emphasis on the digital computer techniques used in controlling the voice transmission paths. The requirements for logic, temporary and permanent memory, recirculating memories, registers, and buffer storage will be discussed. . . .

MESSAGE PROTECTION IN AN AUTOMATIC SWITCHING CENTER
A. S. Rettig, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 606/615.

AutoData is an electronic system for the collection and dissemination of messages in digital form. It is being designed to provide the link between communication facilities and digital data handling equipment. Various levels of message protection are provided to meet the requirements for monitoring and auditing inter- and intra-center traffic. . . . The procedural rules for message acknowledgment assure that incoming messages are adequately identified for future reference and recorded in its entirety before acknowledgment is given to the sender.

LOW-LEVEL MULTIPLEXING FOR DIGITAL INSTRUMENTATION
C. E. Griffen, et al., Electronics, vol. 33, no. 41, Oct. 1960, p. 64/66.

Samples transducer voltages on 48 channels sequentially, producing a serial pulse-modulated output, each channel giving full output with a $\pm$ 5 mV input at a maximum channel rate of 24 kc/s. The resolution at the input is 10 μV. . . .

SYNTHESIS OF A RESONANT TRANSFER FILTER AS APPLIED TO A TIME DIVISION MULTIPLEX SYSTEM
P. T. May, et al., Commun. and Electronics, vol. 79, no. 51, Nov. 1960, p. 615/620, 13 refs.

In a previous paper, Perkins describes a time division multiplex transmission path, developed for use in an electronic switchboard. This transmission path incorporates the use of a "resonant transfer" filter, . . . purpose of this paper is to present a method used to synthesize an economical network whose characteristics will allow it to operate efficiently in this system. . . .

A LOW-LEVEL LINEAR RUNDOWN CIRCUIT FOR PULSE-HEIGHT TO PULSE-WIDTH CONVERSION
D. L. Endsley, et al., Commun. and Electronics, vol. 80, no. 54, May 1961, p. 150/152.

THE BRITISH JERC DEVELOPMENT OF ELECTRONIC SWITCHING
T. H. Flowers, et al., Commun. and Electronics, vol. 80, no. 55, July 1961, p. 208/217.

TRANSMISSION NETWORK OF AN ELECTRONIC CROSSPOINT PABX
R. F. Kowalik, Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 491/496.

. . . transmission network of a private automatic branch exchange (PABX) which is undergoing operational testing at Automatic Electric Laboratories . . .

LOGICAL CONTROL OF AN ELECTRONIC CROSSPOINT PABX
R. P. Sanders, Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 496/501.

FEATURES OF AN ELECTRONIC CROSSPOINT
J. G. Van Bosse, et al., Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 471/474.

Thirteen features characterize the experimental 100-line electronic PABX (private automatic branch exchange), developed at Automatic Electric Laboratories . . .

ELECTRONIC SWITCHBOARD EMPLOYING NEGATIVE IMPEDANCE DEVICES
B. Grace, et al., Radiation, Inc., Melbourne, Fla., Final engineering rept., 1 June 1961-21 May 1962, 31 May 1962, 184 p., incl. illus, tables, 8 refs., AD 283 321.

. . . in a space division matrix . . . traffic studies, development procedures and circuit design for the switching matrix using four-layer diodes. Conclusions are given regarding the selection of a four-layer device and its effect on the over-all size and weight of a 200-line switchboard.

AN ELECTRONIC SWITCHBOARD EMPLOYING NEGATIVE IMPEDANCE DEVICES
B. Grace, et al., Radiation, Inc., Orlando, Fla., Quarterly progress rept. no. 3, 1 Dec. 1961-28 Feb. 1962, 42 p., incl. illus., tables, AD 275 348.

. . . development of the 3-stage rectangular switching matrix circuit. . . .

A MULTICHANNEL PULSE HEIGHT ANALYZER USING PARAMETRON LOGIC
I. Hayashi, et al., Japan. J. Appl. Phys., vol. 1, no. 2, Aug. 1962, p. 125/129.

A time-conversion type 256-channel pulse-height analyser, which makes use of a parametron memory circuit, was constructed. The memory cycle was reduced to 100 μ sec by means of a novel logical circuit. An analogue-digital convertor of the pulse-height analyser can analyse pulses, which come simultaneously from up to eight different counters, and can sort pulses from a counter into up to eight groups, in accordance with coincidence inputs from other counters.

THE SUBSCRIBER-LINE CIRCUIT AND THE SIGNALING AND TONE SYSTEM FOR AN EXPERIMENTAL TIME-DIVISION EXCHANGE FEATURING DELTA-MODULATION TECHNIQUES
H. Inose, et al., IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 397/407.

The time-slot mismatch loss will be avoided and the time-slot assignment will be simplified in a time-division exchange system in which the calling the called subscriber can use independent time slots arbitrarily assigned. Code-modulation techniques make such systems economically realizable, since a tapped magnetostrictive delay line or a shift register can be used to interchange time slots assigned to the calling and called subscribers. . . .

ANALYSE VON LINEAREN NETZWERKEN MIT HAARD-SVALA-SCHALTERN (RESONANZUBERTRAGUNG) (Analysis of Linear Networks with HAARD-SVALA Switches, Resonance Transfer) (In German)
G. Kraus, Arch. Elekt. Uebertragung, vol. 16, Dec. 1962, p. 611/626.

DIGITAL PROCESSES FOR SAMPLED DATA SYSTEMS
A. J. Monroe, New York and London, John Wiley and Sons, Inc., 1962, 490 p., A63-24425.

Detailed study of the digital computer as a data processing device, presenting analytical methods for constructing digital programs and digital-to-analog converter weighting functions. . . . A composite criterion is used for joining transient behavior design and noise-conscious design . . . the basic mathematical tool being the difference equation instead of the Z-transform approach, thus permitting a unified treatment of both linear and nonlinear systems. The second method of Liapunov is used in presenting the design of nonlinear systems.

THE RELATIVE MERITS OF TIME-DIVISION MULTIPLEX VERSUS SPACE DIVISION AS A MODE OF OPERATION FOR ELECTRONIC TELEPHONE EXCHANGES
J. G. Pearce, Commun. and Electronics, vol. 81, no. 59, March 1962, p. 21/27, 13 refs.

. . . A time division system reduces costs and space requirements while approaching the trunking simplicity of a manual system with high-speed single control operation . . .

RESEARCH ON PARAMETRON STORAGE AND CONTROL UNITS FOR A SWITCHING OFFICE
L. Stambler, et al., RCA Defense Electronic Products, New York, Final rept., 1 Oct. 1960-10 April 1962, on An Investigation Leading to the Design of a Parametron Switchboard, Rept. no. CR-61-419-3G, 31 May 1962, 178 p., incl. illus., tables, AD 276 367.

. . . design effort on an automatic switchboard using parametrons in the control circuitry. The switchboard design also contains solid state crosspoints and a transistorized power supply . . . breadboards, representing fundamental switchboard circuitry, illustrate in addition to feasibility the potential miniaturization and reliability of the system.

THE EFFECT OF CONVERSION OF PERIODIC SIGNALS BY SAMPLING ON THE SIGNAL-TO-NOISE RATIO
V. A. Vol, Radio Engng: Transl. of Radiotekhnika, vol. 17, no. 10, Oct. 1962, p. 1/8.

The passage of a mixture of signal and noise through a converter which makes the signal discrete during a finite interval is examined. . . . It is shown that, from the point of view of eliminating noise from a signal, quantizing is similar to linear filtering. It is found that the possible increase in signal-to-noise ratio in filtering of a quantized signal is several times lower than the number of mutually dependent values to be read in the signal. . . .

AN ELECTRONICALLY CONTROLLED PAX-ITS DESIGN AND PERFORMANCE
S. Yamoto, et al, Commun. and Electronics, vol. 81, no. 59, March 1962, p. 1/8.

EVALUATION OF AUTOMATIC ELECTRONIC SWITCHING
Army Electronic Proving Ground, Fort Huachuca, Ariz., Final rept., Aug. 1962, 1v., AD 424 163.

. . . equipment consisted of a family of five electronic switching centrals. . . . A troop test was conducted . . . concluded that the use of automatic electronic switching techniques in tactical communication systems is feasible.

A PDM-TO-DIGITAL ENCODER AND TRANSLATOR
J. D. Cates, et al., IEEE Trans. Commun. Electronics, no. 66, May 1963, p. 131/134.

Development translator resulted from a requirement to preserve the accuracy of pulse-duration modulation (PDM) telemetered data. Deterioration of accuracy in the data reduction or "play-back" of such data is avoided by digitizing the data directly at the output of the receiver and recording the digitized data in serial form . . .

ELECTRONIC SWITCHING FOR COMMUNICATIONS SYSTEMS
P. O. Dahlman, IBM Federal Systems Div., Bethesda, Md., Final rept., Jan.-Dec. 1962, Rept. no. TR-023-027, RADC-TDR-63-47, 26 March 1963, 1v., AD 299 220.

ITT 7300 A. D. X. MESSAGE AND DATA SWITCHING SYSTEM (In French)
O. de Gail, et al., Onde Electr., vol. 43, no. 431, Feb. 1963, p. 153/169.

. . . (Automatic Data Exchange) System. . . designed to meet the various requirements of switching centers for both telegraph messages and data communications. The central part of this system consists of a 5 Mc/s stored program computer which can handle a large number of input and output circuits under the control of a "sequence break" device.

A TIME SLOT INTERCHANGE SYSTEM IN TIME-DIVISION ELECTRONIC EXCHANGES
H. Inose, et al., IEEE Trans. Commun. Syst., vol. CS-11, no. 3, Sept. 1963, p. 336/345.

. . . the time slots are independently assigned to the originating and terminating subscribers and are interchanged, in setting up connection, by means of an appropriate delay or memory device. Such a system, which is economically feasible if the code modulation techniques are employed, increases the efficiency by avoiding time slot mismatch loss and simplifies the time slot assignment procedure. . . .

A MINIATURE MAGNETIC MODULATOR MULTIPLEXER
M. C. Kidd, et al., Rec. Nat. Space Electronics Symp., no. 4.2, 1963.

. . . New techniques developed during the investigation permit the extension of magnetic modulator-amplifiers to high-speed low-level commutating applications. It is now possible for the first time to apply feedback around an entire multiplexer-amplifier combination and obtain the improvements in stability and accuracy that it provides. The restriction of the input circuit bandwidth on the maximum switching speed has been eliminated. These improvements have been accomplished by the use of excitation switching on each modulator instead of signal switching as is normally done. . . .

SIGNAL ANALYSIS II: ESTIMATION OF THE AMPLITUDES OF NARROW BAND DETERMINISTIC SIGNALS OBSERVED INCOHERENTLY IN NORMAL NOISE BACKGROUNDS
D. Middleton, Carlyle Barton Lab., Johns Hopkins U., Baltimore, Md., Technical rept. no. AF-100, Feb. 1963, 103 p., AD 297 870.

A COMPARISON OF LOW LEVEL COMMUTATORS
W. N. Moody, Proc. Nat. Telem. Conf., no. 2-4, May 1963.

FUNDAMENTALS OF THE GENERAL THEORY OF QUASIANALOG SYSTEMS
G. Y. Pukhof, Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio, 22 Jan. 1963, 34 p., (Trans. no. FTD-TT-62-1557/1+2+4 from Izvestiya Vysshikh, Uchebnykh Zavedeniy, Elektromekhanika, no. 9, p. 3/21, 1961, AD 298 210.

VERSATILITY IN TRANSLATING-BROADBAND SWITCHING SYSTEM
W. A. Rust, IEEE Trans. Commun. Electronics, no. 69, Nov. 1963, p. 682/686.

. . . The translator provides "pre-translation" to determine the type of call and number of digits to be anticipated. Originating lines are checked for bandwidth rating, class-of-service, and AN (abbreviated-number) calling group identity. The register-sender is furnished a reconstructed directory number on AN calls.

BROADBAND MATRIX SWITCHING AND TERMINATING EQUIPMENT
R. M. Schildgen, IEEE Trans. Commun. Electronics, no. 69, Nov. 1963, p. 679/682.

. . . discusses the design of a switching matrix that is a combination of relays and diode crosspoints, and the design of line and trunk termination equipment associated with it. . . . will have . . . a frequency-range capability of 15 times the 0-4,000-cycle-per-second range normally used in telephone systems today.

ORIGINATING AND TERMINATING MARKERS—BROADBAND SWITCHING SYSTEM
L. L. Smith, IEEE Trans. Commun. Electronics, no. 69, Nov. 1963, p. 674/679.

. . . Operation of the AR matrix (which connects lines and trunks to the register) and of the line matrix (which connects the calling and called stations) is controlled by Originating and Termination Markers, respectively.

30-CHANNEL MULTIPLEXER FOR LOW-LEVEL OPERATION
H. J. Weber, et al., Space/Aeronautics, vol. 40, July 1963, p. 109/113, A63-18919.

. . . solid-state . . . can process FM and AM signals . . . and dc voltage inputs from a variety of transducers. . . .

Related Publications:

OPTIMUM PREFILTERING OF SAMPLED DATA (Correspondence)
W. M. Brown, IRE Trans. Inform. Th., vol. IT-7, no. 4, Oct. 1961, p. 269/270.

Let f denote a stochastic signal and n denote additive noise; consider a prefilter which prepares f + n for sampling. The sampled data is interpolated to recover an estimate of f. . . .

NEW METHODS OF ANALYSIS OF ELECTROPHYSIOLOGICAL RESPONSES
D. M. MacKay, et al., Keele U. (Gt. Brit.), Final technical rept., 21 June 1962, 24 p., illus., 3 refs., AD 278 590.

. . . development of a simple system for the averaging and analysis of repeated electrical signals . . . Samples are accumulated on a closed loop of magnetic tape, using a special form of pulse-interval modulation, designed also to enable simple circuitry to compute correlations. A low-speed and a high-speed multichannel model have been developed . . .

AN ON LINE SOLUTION TO SAMPLED-DATA TIME OPTIMAL CONTROL
J. H. Eaton, J. Electronics Control, 1st Series, vol. 15, Oct. 1963, p. 333/341, 10 refs., A63-24607.

Analysis of a special purpose computer that is rapid enough to provide an on-line solution to the sampled-data time-optimal-control problem in which the inputs are subjected to amplitude constraints. . . . The time-optimal-control problem is solved by increasing the number of sampling periods until the specified terminal state is reachable.

ANALYSIS OF DELAY IN MATHEMATICAL SWITCHING MODELS FOR DATA SYSTEMS
D. G. Haenschke, Bell Syst. Tech. J., vol. 42, no. 3, May 1963, p. 709/736.

. . . models are designed to permit a study of basic traffic theoretical problems encountered in the rapidly growing field of data communications, but they are not identical with any of the existing data switching systems. Each model assumes that a message is switched only through one switching center which must establish connections via line groups to one or more addressed receiving stations, i.e., each model contains only a single switching center. . . .

AN OPTIMIZATION TECHNIQUE FOR PULSE WIDTH MODULATED SYSTEMS
R. W. Kafka, Coordinated Science Lab., U. of Illinois, Urbana, May 1963, 92 p., AD 406 078.

. . . design of a controller . . . The process to be controlled is time-invariant, of arbitrary order, and excited by a sequence of pulses generated from information available at arbitrary sampling instants. Input information to the system is quite general and includes random and deterministic phenomena . . .

STUDIES IN DIGITAL COMMUNICATIONS. PART I. FEASIBILITY OF ASYNCHRONOUS MULTIPLEXING, PART II. PERFORMANCE OF HIGH-SPEED DIGITAL COMMUNICATIONS OVER TROPOSCATTER LINKS
M. P. Ristenbatt, et al., Cooley Electronics Lab., U. of Michigan, Ann Arbor, Aug. 1963, 101 p., Technical rept. no. 143; 4951 IT, AD 416 647.

. . . showed that synchronous time multiplexing is feasible, under the conditions treated, for systems having as few as 24 sources. It was concluded that the advantage of this method over synchronously multiplexed PCM is about 2.7 for 100 sources, and 2.1 and 24 sources . . . The speech quality with this advantage is not distinguishable, with casual listening, from that of the usual PCM.

Section 3A.57

3A.570: Signal Conditioning Subsystems (Digital and Analog)

Included: Pre-normalization of reconnaissance data; Speech data processing in real time; Digital seismograph systems; Attitude determination; Target enhancement techniques.

Not Included: Speech redundancy reduction (2).

Cross References: Stored program digital processing units (3A.450); Analog control and computing units (3A.530); Data acquisition systems (Sect. 3A.340).

Principal Publications:

DESIGN OF A DIGITAL CODED TELEMETRY SYSTEM
M. F. Easterling, et al., JPL Res. Summ., vol. 1, no. 36-10, June/July 1961, p. 36/41.

. . . using word correlation of the type described in Reference 28, with standard digital equipment (i. e., digital logic, flip-flops, and delay lines). Thus, the task of implementing the system is reduced from one of constructing specific hardware components to one of logical design using digital building blocks. In other words, a telemetry system is treated as a special-purpose digital computer. . . .

AUTOMATIC DETECTION OF CHANGES IN RECONNAISSANCE DATA
A. Rosenfeld, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 492/499.

DATA PROCESSING FOR THE GODDARD EXPERIMENT
D. S. Kushner, Rec. Nat. Symp. Space Electronics Telemetry, no. 4.4, Oct. 1962.

. . . designed to measure the ultraviolet radiation from stars over a range of spectral wavelengths. The Data Processing Subsystem of the experiment accumulates and processes the experimental data and controls the performance of the experiment.

Six parallel data channels accumulate pulses that represent the intensity of radiation at six different incremental portions of the ultraviolet spectrum. . . sequentially sampling . . . automatically. . . Data accumulated. . . stored in spacecraft memory. Compression techniques are employed to reduce the number of bits that must be stored. . . .

A HIGH-SPEED, SOLID-STATE, DIGITAL SCANNER FOR USE WITH THE ERA 1102 COMPUTER
G. R. Mozer, et al., Arnold Engineering Development Center, Aro Inc., Arnold Air Force Station, Tenn., AEDC-TDR-62-61, March 1962, 49 p., AD 273 607, N63-17686.

. . . for entering data into the raw-data system of the ERA-1102 computer. . . built for the PWT 16-ft supersonic tunnel.

OPTICAL TECHNIQUES FOR TARGET ENHANCEMENT AND BACKGROUND REJECTION

R. S. Neiswander, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 549/555.

. . . special techniques related to the data processing of radiant energy are discussed. The problem area is further restricted to the category of optical sensors typically employed for space reconnaissance, surveillance and exploration operations where on-board decisions with regard to wanted vs. unwanted targets are to be made. . . . Of particular interest here is the potency of the nonlinear processing, which, for example, can completely eliminate difficult backgrounds such as semi-infinite discontinuities in favor of point targets. . . The target data is optically encoded in a form such that it is simply extracted from the subsequent video signal. . . .

SPEECH DATA PROCESSING IN REAL TIME

H. A. Straight, Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 30/35.

The logical techniques by which a high-speed special-purpose digital computer developed by Melpar compares the digital description of speech spectrum patterns with previously recorded description are presented. This set of logic is capable of determining which stored pattern most nearly approximates an unprocessed pattern, and is unique in that it makes possible the sorting and compilation of speech statistics in real time. . . . capability of "learning" speech through the tabulation of a set of mean patterns. . .

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING

J. S. Albus, et al., IEEE Trans. Space Electronics Telemetry, vol. SET-9, no. 3, Sept. 1963, p. 71/77.

. . . orientation of spin stabilized satellites . . . Aspect information is collected optically from the sun, moon and earth. . . . Some interesting results of aspect measurements on Explorer XII showed an unexpected increase in spin rate due to solar pressure, and on Explorer XIV an erratic precession history. . . .

A SYSTEM OF AUTOMATIC CONTOUR DISPLAY (AUTOCON)

W. W. Anderson, Marine Engineering Lab., Annapolis, Md., MEL Research and Development rept. no. 81284, 11 Sept. 1963, lv., AD 417 193.

. . . receives analog information from a plane of equally spaced data points and simultaneously converts this information into complete contour response surface plots. The system employs a series of analog storage, scanning, and interpolation operations which take a finite number of data points in a plane, and, from them, generate an interpolated surface over all these points. As the surface is generated, it is quantized into discrete contour levels which are then drawn on a stored television display for immediate use and on 35-mm film for a permanent record. . . . The system's chief advantage in its present use of stray magnetic field investigations is the elimination of the time required to obtain contour displays of 1 or 2 hr. by manual plotting.

THE PRENORMALIZATION OF RECONNAISSANCE DATA

J. F. Bogusz, et al., Philco Corp., Blue Bell, Pa., Final rept., 25 May 1962-25 June 1963, Rept. no. V044F, RADC TDR 63 372, 25 July 1963, AD 422 946, N64-12646.

Several techniques are described and evaluated for the prenormalization of gray-scale aerial photographs prior to their use as input to an adaptive memory recognition system. It summarizes the evidence for analagous preprocessing operations in the animal visual system. . . techniques which reduce the gray-scale input data to binary form. . . comparing recognition error rates on a computer-simulated adaptive memory recognition system. . . .

A STUDY AND INVESTIGATION OF THE OPERATIONS CENTRAL AN/MSQ-16 (XW-2)

P. M. Brown, et al., Griffiss AFB, N. Y., Rome Air Develop. Center, Final Report, RADC-TDR-63-403, Dec. 1963, 193 p., refs., AD 426 758, N64-13783.

. . . various expected signal sources are analyzed, and the required equipment performance in terms of antenna gains and receiver sensitivities is specified. . . it is concluded that an RF differencing monopulse-type tracker can provide the required angle tracking performance over the RF tuning range of 0.1 kMc to 18 kMc, with this range divided into six bands. . .

INVESTIGATION OF SPACE PROBE DATA CONDITIONING AND REDUCTION METHODS

D. B. Brzezenski, et al., Wolf Research and Development Corp., West Concord, Mass., Final rept., AFCRL 63 842, 20 June 1963, 53 p., AD 415 945, N63-20913.

The data collection and processing methods of the scientists conducting rocket probe and satellite experiments were studied. The best procedures to be used for data conditioning, decommutation, and digitizing for entry into a large scale computer were recommended and a trial program written and tested. . .

ELECTRONIC SIGNAL PROCESSING FOR INFRARED TRACKING AND RADIOMETRIC INSTRUMENTATION

D. W. Fisher, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 793.

. . . particularly as used on the Atlantic Missile Range. Block diagrams of two types of position encoded signal processing systems are discussed. Decoding involves both pulse-time and pulse position demodulation techniques. All vacuum tube and all transistor systems have been used and comparisons are drawn between them. . . abstract only.

PITCH EXTRACTION BY COMPUTER PROCESSING OF HIGH-RESOLUTION FOURIER ANALYSIS DATA
C. M. Harris, et al., J. Acoust. Soc. Amer., vol. 35, March 1963, p. 339/343, A63-19845.

. . . automatic pitch-extraction method, in which speech signals are processed by a real-time Fourier analyzer, the output of which is converted into digital form and recorded on tape for processing on an IBM computer. The logic of the computer program, written in FORTRAN language, is discussed, as is the accuracy of the overall pitch-extraction system.

PRACTICAL ASPECTS OF DATA PROCESSING AND ENCODING FOR SPACE COMMUNICATIONS
G. E. Mueller, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 471/487.

. . . Communications from spacecraft. . . Surveyor. . . Aeros. . . Ranger. . . OAO. . . Relay. . . Telstar. . . discussing methods for processing and encoding data from spacecraft. . . Four factors must be considered in the process of translating measurements and events at a spacecraft into a form suitable for telemetry transmission; filtering, encoding, the choice of format for this code, and the capability for decoding. . . . each of these will. . . be reviewed. . .

ELECTRONIC AUDIO RECOGNITION STUDY
A. E. Murray, Cornell Aeronautical Lab., Inc., Buffalo, N. Y., Final progress rept., 1 July 1962 - 31 July 1963, Rept. no. UB 1721X4, 31 July 1963, p. 61, AD 429 894.

Research . . . on the feasibility of an electronic device capable of detecting and classifying moving targets by processing the audio output of battlefield surveillance doppler radars. The desired classification categories are personnel, vehicles, and natural clutter. . . .

DIGITAL ENCODER AND PAPER TAPE PUNCH
E. D. Squier, Marine Physical Lab., U. of Calif., San Diego, Rept. no. MPL-U-25/62; SIO reference 63-1, 1 Feb. 1963, p. 7, AD 401 135.

. . . consists of a 200-channel input scan switch, an analog-to-digital converter, and a paper tape punch. Input voltages are encoded into 4-, 8- or 12-bit words and punched on paper tape as 4-bit characters at rates up to 50 characters per second. . . . for use in the Bendix G15 computer.

A HIGHLY VERSATILE TELEMETRY DATA TRANSLATION SYSTEM
J. Wiren, Northeastern U., Boston Mass., Final rept., AFCRL 63 814, 30 June 1963, 24 p., AD 416 637.

In support of the upper-air research program, a facility for translating continuous analog data and pulse amplitude time multiplexed data into digital formats on magnetic tape suitable for entry into large computers has been developed. A description of a computer controlled Telemetry Data System and some of its operational features are presented . . .

DEVELOPMENT OF AN ADVANCED CONDITIONED REFLEX MODEL
Scope, Inc., Falls Church, Va., Final technical rept., ASD TDR 63 667, 25 Sept. 1963, 84 p., AD 422 467.

. . . consists of an optical sensory (input) system and a digital data processor . . . capability of up to 48 distinct pattern classes. . . . Information extracted by the sensory system is accumulated in the data processor and the reference functions are formed for each pattern class . . .

DIGITAL SEISMOGRAPH SYSTEM
Texas Instruments, Inc., Dallas, Final Report, AFCRL-63-433, March 29, 1963, 170 p., refs., N63-17439.

. . . The approach chosen for complete system design was termed the FM-Digital approach. . . . generates a zero-to 40 megacycle FM deviation which drives a binary counter for 20 bits of digital conversion at a 40-cps rate. . . . comparision with a conventional three-component Benioff Seismograph . . . requires the use of computer analysis of data obtained.

Related Publications:

S-51 REAL TIME DATA REDUCTION SYSTEM
H. H. Levy, et al., NASA, Goddard Space Flight Center, Greenbelt, Md., NASA-X-50025; Sept. 1962, 63 p., N63-16717.

. . . decommutates and recogizes an analog and digital pulsed frequency modulated telemetry format of 16 channels per frame at a rate of 50 channels per second. . . .

AN EXPERIMENTAL VIDEO TRACKING SYSTEM FOR APPLICATION IN AIR TRAFFIC CONTROL
L. F. Stinson, IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 4, Dec. 1962, p. 200/210.

. . . This system communicates directly with a general-purpose digital computer and is capable of generating and controlling 50 analog video trackers which can operate in either a

Track-While-Scan or Rate-Aided mode. Additionally, the system provides aircraft position information to the computer for mathematical calculations of aircraft position errors, and processes computer-derived information for presentation on Plan Position Data Displays for controller use. . . .

A METHOD OF DATA ACQUISITION AND SYSTEM CONTROL THROUGH TIME SHARING OF MIXED INPUTS
B. Brentnall, et al., Stanford U., Calif., Feb. 1963, 33 p., AD 406 931.

. . . outputs from the devices and varied transducers . . . cover the whole spectrum of electrical signals - dc, ac, and frequency . . . an inexpensive recording system which can accept any or all of these types of input, sample the various channels in turn and present the time dependent data as an accurate numerical quantity is clearly desirable. . . . progress made in the design of such an instrument.

COMPUTER REQUIREMENTS: DATA CONSTRUCTION, INPUT, AND INITIAL PROCESSING. FEASIBILITY STUDY OF A TRACK-WHILE-SCAN NAVIGATION CONCEPT
J. E. Carroll, Control Data Corp., Minneapolis, Minn., Aerospace Research, CDC-TM-9552-7, 8 Nov. 1963, 38 p., refs., N64-19256.

A discussion is presented of the detection process wherein information passes successively through the camera slits, photomultiplier, transmitter, receiver, and electronics buffer, and finally comes to rest in the computer memory. Two signals are actually processed-phototube anode current and multiplier voltage. . .

Section 3A.58

3A.580: Signal Processing Subsystems

Included: Radar signal processing units; Computer programs for signal processing; ATC signal processing; Telemetry data reduction systems; Radar data processing; Automatic analysis of telemetry data; Post detection data compression; Target enhancement; Telemetry data translation systems; Degarbler program; Snow removal in pictures; Antenna signal processing.

Not Included: Map compilers (2); Pattern recognition methods (2); Data compaction methods in general (2); Post detection smoothing techniques (2); Antenna theory and design; Diversity reception techniques (2); Correlation detection fo data signals (1); Radar techniques; Radar detection theory.

Cross References: Computer programming in general (3A.150).

Principal Publications:

DETECTION OF RADAR SIGNALS BY DIRECT MEASUREMENT OF THEIR EFFECT ON NOISE STATISTICS
G. I. Cohn, et al., Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 821/831.

. . . paper is concerned with the development of methods for storage and selective readout of radar information in such a manner as to increase the probability of making a correct decision . . . a detection method which is directly responsive to changes in noise statistics caused by the presence of a pulse. . . .

COMPUTER - RADAR ENVIRONMENT INTERPLAY
R. R. Fidler, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 575/585.

This paper is primarily directed toward the everpresent problem of radar data conversion, particularly where real-time data processing is required. . . .

TIME DOMAIN ANTENNA TECHNIQUES
T. S. Fong, et al., Hughes Aircraft Co., Culver City, Calif., Rept. no. P61-22, RADC TN 61-290, Oct. 1961, 46 p., incl. illus. table, 7 refs., AD 276 699.

Time modualtion of array antennas was applied to the problems of obtaining ultra-low sidelobe and simultaneously scanned antenna patterns . . . A simplified experimental array design . . . switching circuitry . . . Stable transmitting and receiving equipment. . . . final results . . . concluded that 40 db sidelobes can be measured to within ±1.5 db on the present range. The basic theory of the technique of simultaneous scan is given.

ALTITUDE PROCESSING IN THE ATCRBS
J. Freibaum, IRE Trans. Aerospace Navig. Electronics, vol. ANE-8, no. 4, Dec. 1961, p. 149/152.

. . . to enhance the operational capability of the Air Traffic Control Radar Beacon System (ATCRBS). . . . The fully transistorized processor converts beacon video code trains from serial to parallel form. Leading edge decoding, pulse regeneration, pulse standardization, and destructive readout techniques are used to detect and eleminate spurious or garbled codes and to correctly process closely interleaved replies. . . .

MAGNETICS IN DOPPLER SIGNAL DATA EXTRACTION
R. J. Metz, et al., Commun. and Electronics, vol. 80, no. 53, March 1961, p. 33/43.

. . . a solid-state approach to the Doppler radar data extraction problem using nonlinear magnetic techniques. . . .

A square-loop magnetic core was chosen as the integrator in view of its easy compatibility with the switching requirements of the interrogation or sampling process. . . . Envelope detection of the predetection filter output can be conveniently mechanized to aid the core integration process by using a grounded-base transistor as a coupling element between the filter and PDSI core. . . .

REAL-TIME, DIGITIZED TILT CANCELLATION FOR DRONE AND SATELLITE PHOTOGRAPHY
W. D. McJunkin, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 99/105.

. . . concept of combining rectification and transmission functions into one integrated operation evolved during a study of map compilation sponsored by the U. S. Army . . . No apparatus exists at present . . . Full exploitation of the concept will require much development effort in improving linearity of electronic scanners. . . .

STATISTICAL TREATMENT OF RADIO SIGNALS BY COMPUTERS
A. V. Prosin, et al., Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 5, 1961, p. 93/101.

An account is given of a method of handling signal data automatically in a digital computer. . . . computer programme is also described. . . .

VIDICON DATA HANDLING
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 3/4.

. . . The techniques discussed . . . are new insofar as the digital computer has not previously been used to substitute for analog corrections of photographic materials. . . . Application of the computer to remove noise by comparing each line to its neighbors and watching for unusual events. . . . It should be possible to store three complete pictures of the RA-3 type in the computer at one time.

DETERMINATION OF SIGNAL FREQUENCY, PHASE AND AMPLITUDE FROM THE OUTPUTS OF THE SEQUENTIAL DOPPLER PROCESSOR FINE DOPPLER INTEGRATORS
F. C. Bequaert, et al., MITRE Corp., Bedford, Mass., Technical memo no. TM-3410, ESD TDR 63-203, Oct. 1962, 25 p., AD 298 263.

ANALYSIS OF SIGNAL PROCESSING DISTORTION IN RADAR SYSTEMS
J. V. DiFranco, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 2, April 1962, p. 219/227.

. . . A measure of the loss in performance is obtained by the development of a modified radar "uncertainty function" which results from the presence of time-and frequency-domain distortions in the system. Losses due to the major sources of distortion are evaluated and several compensation techniques discussed. . . .

ON A METHOD OF SIGNAL EXTRAPOLATION BY POWER SERIES
A. A. Gorbachev, Radio Engng: Transl. of Radiotekhnika, vol. 17, no. 7, July 1962, p. 9/12.

A method of extrapolating signals interrupted by pulse interference is examined. The method is based on the use of loops of series-connected RC sections. . . .

A PROGRAM FOR THE ASSEMBLY AND DISPLAY OF RADAR-ECHO DISTRIBUTIONS
E. Kessler, III, et al., Travelers Research Center, Inc., Hartford, Conn., Tech. Memo. 7044-41; Tech. Publ. 21, Oct. 1962, 62 p., 9 refs., N63-19917.

THE EQUIVALENCE AMONG THREE APPROACHES TO DERIVING SYNTHETIC ARRAY PATTERNS AND ANALYZING PROCESSING TECHNIQUES
H. L. McCord, IRE Trans. Mil. Electronics, vol. MIL-6, no. 2, April 1962, p. 116/119.

The equivalence of the vector addition, cross-correlation, and filtering approaches to deriving synthetic array patterns and analyzing processing techniques is demonstrated here. A mathematical model is defined . . . A synthetic array radar consists basically of a coherent radar whose antenna becomes a new element of the synthetic array with each succeeding transmission, and of a data-processing system whose function is to store and to sum coherently the data collected (with successive pulses) by the antenna. . . .

AUTO-DRAPE- A REAL TIME TELEMETRY REDUCTION SYSTEM
M. S. McFarland, Rec. Nat. Symp. Space Electronics Telemetry, no. 3.2, Oct. 1962.

. . . It accepts telemetry data in real-time, demultiplexes and compares the data, point by point, against corresponding limits. The system is capable of processing all PAM/FM solid state commutated data at rates up to 40 kc . . . operational in June 1962. . . .

WEAK-SIGNAL ANALYZER USED IN RADAR CONTACT WITH VENUS IN 1961 (Translation)
V. A. Morozov, et al., Radio Engng. Electronic Phys., vol. 11, Nov. 1962, p. 1740/1748, 10 refs., A63-20084.

Description of a multichannel weak-signal analyzer, designed for the investigation of signals with considerably less power than the noise background power in the frequency range occupied by the signal . . . measurement procedure for investigating both the wideband and narrowband components of the signal. . . .

SIGNAL FIDELITY IN RADAR PROCESSING
W. A. Penn, IRE Trans. Mil. Electronics, vol. MIL-6, no. 2, April 1962, p. 204/218.

. . . In this paper the loss of information caused by signal interference in correlation or matched filter techniques is evaluated in an approximate manner. This is related to the invariance of the total integral of the Woodward ambiguity function. Degradation of the desired signal due to the statistical fluctuation of the signal itself is also considered. The distinction between pre-detection integration is made. . . . Finally . . . comments are made on the philosophy of providing adequate gray-level rendition in radar displays. Attention is given to reconciling the dynamic ranges of the display and the signals, and to the number of resolvable gray levels available in the signal. . . .

SCAMP—A SINGLE-CHANNEL MONOPULSE RADAR SIGNAL PROCESSING TECHNIQUE
W. L. Rubin, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 2, April 1962, p. 146/152.

. . . requires only a single If amplifier channel to instantaneously process the returns from all targets within a band-width. The basic signal processor consists of a wide-band amplifier-hard limiter, followed by appropriate band-pass filtering. . . . Angle accuracy curves for a sum and difference monopulse system are derived as a function of input SNR. . . .

P.F.M. SIGNAL PROCESSING
C. M. Stout, Proc. Nat. Telem. Conf., vol. 2, no. 3-5, April 1962.

. . . problems presented to the ground processing system through the use of several variations of the basic P.F.M. system . . . Since this particular type of modulation is relatively new, off the shelf items were not available . . . Ground Processing of Explorer XII Signals . . .

ADVANCED RECEIVING TECHNIQUES
JPL Space Progr. Summ. vol. 1, no. 37-14, Jan./Feb. 1962, p. 111/116.

. . . This discussion describes, in some detail, a special purpose computer which can measure the autocorrelation function of the signal as fast as samples arrive; so that the answer is ready at the end of the observation.

DIGITAL INSTRUMENTATION SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 24/26.

. . . for installation at the Goldstone Echo Station. . . . to record information from the DSIF ground equipment, in digital form, on magnetic tape in a format compatible with the IBM computers in use at JPL. Information recorded by the system will be reduced at a later time on the JPL computers.

DATA HANDLING SYSTEM FOR VENUS SITE
JPL Space Progr. Summ., vol. 3, no. 37-16, May/ June 1962, p. 20/24.

. . . The system will serve both antennas at the site. . . . will be capable of sampling external inputs of data condition, angular position of the antenna, and ranging data. . . . The output . . . will be paper tape punched in standard teletype code by two BRPE high speed punches.

SIGNAL PROCESSING IN THE J. P. L. VENUS RADAR
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 42/47.

. . . operates on the received signal in such a way as to extract from it useful information about Venus. This must be done in conjunction with the type of modulation transmitted, as Venus may be expected to interact differently with various waveforms which illuminate it. For example, a keyed sinusoid is used for the measurement of received signal power and echo spectra, whereas the RF carrier is modulated with a range code for the measurement of range or when using a programed range gate to select echoes from a particular region of the planet's surface.

MACOMATIC CORRELATION SIGNAL PROCESSING SYSTEM
W. B. Allen, et al., Navy Electronics Lab., San Diego, Calif., NEL-1161, 14 March 1963, 39 p., 8 refs., N63-18854.

. . . developed for incorporation into a pseudorandom-signal-correlation sonar system. . . . highly flexible input sampling rate—any rate up to 400 bits per second—and a storage capacity of 2048 bits. Special timing pulses in the core matrix permit Doppler correction by adding or subtracting bits of information to effectively compress or expand the stored signal . . . recommended particularly for use with spectrum analyzers for investigating low- and very-low-frequency phenomena.

DIGITAL SIGNAL-BEHANDLING AV RADARINFORMATION (Digital Radar-Data Signal Handling) (In Swedish)
L. Appelgren, et al., Teknisk Tidskrift, vol. 93, Nov. 1, 1963, p. 1077/1081, 15 refs., AD64-14105.

SPECIAL PURPOSE ANALYSIS TECHNIQUES
R. Archbald, et al., New York U. Coll. of Engineering, 5 April 1963, 88 p., AD 409 499.

A computer program for determining the direction of a signal using the computer analyzer is described. Preliminary analysis for setting the threshold on the computer analyzer is outlined . . .

SPECIAL PURPOSE ANALYSIS TECHNIQUES
R. Archbald, et al., New York U., Coll. of Engineering, N. Y., Quarterly rept. no. 4, 5 Oct. 1962-5 Jan. 1963, 5 Jan. 1963, 102 p., AD 407 130.

. . . experimental setup of a computer analyzer for signal analysis problems. . . A computer program to compile and maintain a file of signals based on signal frequency and average prf is explained. . . . A description is given of an automatic direction finding system potentially capable of providing an azimuth vs. frequency display.

SYNTHESIS AND OFF-LINE EVALUATION OF A MULTICHANNEL FILTER SYSTEM DESIGNED FROM A THEORETICAL MODEL OF SIGNAL AND NOISE FOR THE ENHANCEMENT OF MANTLE P WAVES
R. Baldwin, et al., Texas Instruments, Inc., Dallas, 15 Sept. 1963, 116 p., AD 436 039.

. . .An off-line evaluation was performed by processing actual recorded data from CPO through a computer simulation of the on-line Multiple Array Processor (MAP). . . .

DESIGN AND APPLICATION OF COMPUTERS FOR RADAR DATA PROCESSING
R. A. Ballard, et al., Radio Electronic Engineer, vol. 26, Nov. 1963, p. 407/415, Discussion, p. 416, A64-11884.

Description of the operational tasks which will have to be carried out by a radar data handling system associated with an ATC center. . . . Consideration is given to the possible use of analog and special-purpose computers, but it is concluded that a general-purpose digital computer would be required . . .

METHOD OF INCREASING THE NOISE IMMUNITY OF TELEPHONE SIGNALS
S. P. Baronin, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 3, March 1963, p. 28/35.

. . . It is shown that the use of a filter with variable parameters, capable of tracking the statistical features of the signal and noise, enables the received signal to be converted to a form more convenient for perception. The block diagram of a suitable circuit is described, and an approximate calculation of the efficiency obtained is given. . . .

ON AERIALS AND DATA PROCESSING
R. N. Bracewell, In: Radio Waves and Circuits: Proceedings of Commission VI on Radio Waves and Circuits during the XIIIth General Assembly of URSI, London, Sept. 1960, Edited by Samuel Silver, New York, Elsevier Publishing Co., 1963, p. 287/295. 14 refs., A64-10839.

Discussion of the connection which exists between linear signal analysis and the data-gathering function of the antenna in radio astronomy . . .

RADAR VIDEO DATA HANDLING
T. J. Burke, Radio Corp. of America, Moorestown, N. J., 1963 9 p., AD 407 763.

. . . The specialized video data collection equipment is described which includes the instrumentation receivers, video multiplexer and a wide band width recorder. . . .

DIGITAL DATA PROCESSING CONSIDERATIONS IN RADAR
P. J. Child, Radio Electronic Engineer, vol. 27, Jan. 1964, p. 75/83, 13 refs., A64-14765.

. . . the performance of a sampling detector which samples twice per pulse length if the signal/noise ratio is considered constant at all sampling instants. If the shape of the video pulse due to finite receiver bandwidth is considered, improvement may result from sampling more than once per pulse length. . . .

OPTIMUM SIGNAL PROCESSING IN THE PRESENCE OF SPATIAL NOISE
D. G. Childers, et al., University of Southern Calif., Engineering Center, Los Angeles, USCEE Rept. 108, March 1964, 88 p., AD 437 824.

An optimum signal processing theory for active radar (sonar) arrays is developed. . . . An optimum linear processor is developed which maximizes the output signal-to-noise ratio when the input is known signal imbedded in correlated and uncorrelated noise. The signal processing theory requires a knowledge of some of the statistical properties of the noise field. Therefore, a stochastic representation for a general, polarized, nonisotropic noise process is formulated. This representation is used to determine the cross-spectral densities and cross-correlation functions between antenna array element in the presence of the noise field only.

COORDINATE METHOD OF CONVERTING RADAR ECHOES TO DIGITAL FORM
W. Clyma, et al., J. Geophys. Res., vol. 69, April 15, 1964, p. 1497/1500, A64-17196.

Radar echoes can be converted to digital form by means of a sequence of (x, y) coordinates obtained around the periphery of the echo. Procedures for computing echo areas and centroids from the (x, y) coordinates are presented. Computations are made by a high-speed computer. Other radar characteristics can also be computed and summarized using the method described.

RADAR DETECTION OF IONIZED NITRIC OXIDE IN THE LOWER ATMOSPHERE
L. Colin, Stanford Electronics Lab., Stanford U., Calif., Final rept., Rept. no. SEL63 089, Oct. 1963, 106 p., AD 430 099.

. . . The analysis technique developed and used, based on electronic filtering and integration, is shown to be optimum for power spectral density estimation. . . .

AN OUTLINE AND DISCUSSION OF THREE PROPOSED METHODS FOR THE DATA ANALYSIS OF RADAR RETURN PULSES
G. W. Evans, II, et al., Stanford Research Inst., Menlo Park, Calif., Memo Rept. 5, Aug. 1963, 36 p., AD 415 906, AD 418 485.

This report suggests extensions for the application of the covariance and power spectral density functions and for the finite Fourier transform and conjugate transform . . . for the analysis of radar return pulses when more than one data sample may be extracted from each return pulse.

COMPUTER PROGRAMS FOR PROCESSING SIGNALS RECEIVED IN RADAR ASTRONOMY EXPERIMENTS
P. L. Fleck, Jr., et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. 64G-4, 16 Aug. 1963, 29 p., refs., AD 429 085, AD 419 091, N64-14837.

TARGET SIGNATURE STUDY
B. F. Goodrich, et al., Michigan U. Coll., Michigan U., Coll. of Engineering, Ann Arbor, Rept. no. 5172 6Q, Nov. 63, 30 p., AD 431 637.

. . . investigation to determine an optimum method of identifying military targets by radar menas, The mixed filter is analyzed in detail using machine simulations. A quantitative estimate of the resolution as a function of the filter parameter is obtained for a given target. . . .

FINE GUIDANCE SENSOR FOR HIGH PRECISION CONTROL OF THE OAO
N. A. Gundersen, American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., Paper 63-211, June 17-20, 1963, 12 p., A63-18437.

. . . Experiment to investigate the extremely fine absorption lines which are expected to be observed when examining the radiation from selected stars. . . . electronics for signal processing . . . automatic gain control. . . .

RESTORATION OF ATMOSPHERICALLY DISTORTED IMAGES
J. L. Harris, Visibility Lab., U. of Calif., San Diego, March 1963, 109 p., AD 404 873.

. . . Considerable progress has been made in the development of techniques which may be suitable for the restoration of images.

A DATA HANDLING SYSTEM FOR A RADAR INSTALLATION
J. E. Harrison, et al., Society Instrument Technology, Meeting, London, England. March 24, 1964, Preprint. 20 p., 10 refs, A64-15856.

. . . facilities for the on-line display of tracking data and for the control auxiliary measuring equipment. Due to the use of digital techniques, the high accuracies obtained from the tracking radars are maintained, even on the maximum scale factor expansion of 128 times . . .

AN AUTOMATIC DETECTION AND DATA EXTRACTION SYSTEM FOR SECONDARY RADAR
T. R. Hopgood, In: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, Collected preprints, p. 125/128, A64-12841.

. . . The problems to be solved by the equipment are framing pulse recognition, fruit elimination, paint detection, range extraction, bearing extraction, and reply code extraction. Wherever possible, these problems have been solved within a general purpose framework since this means that one computing device can be time shared between several different functions . . .

TRANSVERSE DOPPLER PATTERN MEASUREMENT TECHNIQUE
H. H. Hougardy, et al., Teledyne Systems Corp., Hawthorne, Calif., Final rept., Rept. no. 63ESD18, AFCRL 63 94, 1 Feb. 1963, 92 p., AD 408 271.

. . . The signal processing systems investigated include multichannel processing, synthetic aperture processing, and directional and non-directional sampling antennas . . .

RADIO-INTERFEROMETER ANALOG PHASE-CHANNEL COMBINER (MOD II) FOR UNAMBIGUOUS SPACE ANGLE MEASUREMENTS IN THE NAVY SPACE SURVEILLANCE SYSTEM.
M. G. Kaufman, et al., Naval Research Lab., Washington, D.C., Final rept., NRL 5980, 30 Oct. 1963, 62 p., AD 423 924.

An electronic system called the MOD II phase-channel combiner is described, which automatically combines several noise phase channels into one quiet channel, with two additional channels being available for vernier readout. . . . time displacement is detected and transformed into a dc voltage by an analog phase meter for presentation on a recorder, or it is digitalized and fed to a computer.

A SYSTEM ORIENTED PCM GROUND STATION INCORPORATING DATA COMPRESSION
L. J. Lauler, Rec. Nat. Space Electronics Symp., no. 4.4, 1963.

. . . This paper presents the design of a PCM decommutation system utilizing a core memory for program storage. . . . solution of the problems associated with on-line computer operations.

. . . the "floating aperture" scheme has been found to be an effective T/M data compressor performing redundance reduction at moderate hardware cost. . . .

THE DEGARBLER—A PROGRAM FOR CORRECTING MACHINE-READ MORSE CODE
C. K. McElwain, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, 25 Oct. 1963, 17 p., AD 405 394.

An IBM 7090 program automatically corrects garbled samples of English text. The garbles are intended to resemble those caused by Morse Code transmissions. The program has access to a vocabulary and a table of the Morse Code equivalents of the English alphabet. The correction rate on text in which 0-10% of the characters have been subjected to Morse Code garbles is about 70%. The apparent improvement in intelligibility is very marked.

THE COMPARATIVE EFFECTIVENESS OF SEVERAL TELEMETRY DATA COMPRESSION TECHNIQUES
J. E. Medlin, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 328/340.

. . . comparisons were made by simulation with an IBM 7090 digital computer with the use of approximately 150,000 samples of actual vehicle telemetry data received during a typical satellite launching. The five compression techniques discussed in this paper employed zero or first-order polynomial predictors, or modifications thereof. . . . In another portion of the paper, brief descriptions are presented of two data compressors, including one spaceborne unit, which have been mechanized at L.M.S.C. . . .

ADVANCED RADAR SIGNAL AND DATA PROCESSING IV
A. I. Mintzer, Space/Aeronautics, vol. 39, May 1963, p. 97/107, A63-18831.

Continued discussion of. . . signal parameter estimation. . . with emphasis on time multiplex (sequential) and space multiplex (simultaneous). . . . functions performed by data processing and modern trends in radar systems.

AUTOMATIC TAPE-EDITING EQUIPMENT
A. G. Ratz, et al., IEEE Trans. Space Electronics Telemetry, vol. SET-9, no. 2, June 1963, p. 51/60.

The need for automatically combining fragmentary telemetry tape records into one complete over-all composite record is discussed. The over-all organization of a tape-editing system is broken down into its two main functions: 1) synchronizing the tape transports, 2) measuring the excellence of the tape signals and then carrying out the diversity combination of these signals to form a new edited record. . . . a practical tape editor system. . . is described. . . .

ANTENNAS AND DATA-PROCESSING TECHNIQUES
S. Silver, In: Radio Waves and Circuits; Proceedings of Commission VI on Radio Waves and Circuits during the XIIIth General Assembly of URSI, London, Sept. 1960, Edited by Samuel Silver, New York, Elsevier Publishing Co., 1963, p. 296/306. A64-10840.

Discussion of the general problem of the detection of signals by a system of receiving antennas and the generation of effective receiving patterns by data-processing techniques. . . .

THE ANALYSIS OF MULTIPLE SIGNAL DATA
J. W. Smith, IEEE Trans. Inform. Th., vol. IT-10, no. 3, July 1964, p. 208/214.

. . . In particular, filters which modify their structures in order to recognize initially unknown waveforms in Gaussian noise and an unknown signal environment are investigated experimentally. . . . Problems which fit into the broad category described are: 1) Radar detection in a multiple emitter environment; 2) Multiple signal communications systems such as hand-sent Morse code; 3) Medical or reconnaissance data.

AUTOMATISCHE AUSWERTUNG DIGITALISIERTER RADARSIGNALE (Automatic Evaluation of Digitized Radar Signals) (In German)
W. Storz, et al., NTZ - Nachrichtentech., vol. 16, Dec. 1963, p. 643/648, A64-13724.

Demonstration that for equal error probability and equal echo-signal-to-noise ratio the probability of detecting an aircraft by a digital detector is not substantially reduced when the radar video signal in front of the detector is digitized in unity bits. By using the theory of statistical decisions, criteria are quoted for this form of data processing which ensure an optimum probability of detection and a minimum scattering of the angle indication. . . .

PULSE-COMPRESSION SUBSYSTEM FOR A DOWN-RANGE TRACKER
C. L. Temes, et al., IEEE Internat. Conv. Rec., Pt. 8, vol. 11, March 1963, p. 71/81.

. . . Concepts and implementation are described for a high-resolution pulse-compression subsystem installed in a Down-Range tracking radar of the Atlantic Missile Range. . . . The subsystem transmits a 4mc frequency ramp and achieves a nominal range resolution of 120 feet with a time bandwidth product of 8000. Sidebobes in the compressed pulse are suppressed by means of Hamming amplitude weighting, which is theoretically capable of yielding a maximum sidelobe level of -42.8db with respect to the main pip. The technique is also capable of achieving a Doppler resolution of better than one cps by means of multiple-pulse coherent processing. . . .

THE STRUCTURE OF EFFICIENT DEMODULATORS FOR MULTIDIMENSIONAL PHASE MODULATED SIGNALS
H. L. Van Trees, IEEE Trans. Commun. Syst., vol. CS-11, no. 3, Sept. 1963, p. 261/271.

. . . concerned with optimum processing schemes for analog modulated signals. . . . consider both real-time and nonreal-time processing. . . .

THE AUTOMATIC ANALYSIS OF TELEMETERED DATA
A. P. Willmore, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 299/306.

. . . The data processing operations used on the Ariel I satellite are described, together with an almost entirely automatic method which has been used for the analysis of measurements of electron temperature in the ionosphere. The method is illustrated by describing some results of this experiment. . . .

A HIGHLY VERSATILE TELEMETRY DATA TRANSLATION SYSTEM
J. Wiren, Northeastern U., Boston, Mass., Final Report, AFCRL-63-814, June 30, 1963, 25 p., 1 ref., N63-21923.

. . . facility for translating continuous analog data and pulse-amplitude time-multiplexed data into digital formats on magnetic tape suitable for entry into large computers. . .

OPTICAL TECHNIQUES FOR TARGET ENHANCEMENT AND BACKGROUND REJECTION
Te Co., Santa Barbara, Calif., Final technical rept., June 1963, lv., AD 408 268.

Techniques for processing radiant energy information have historically been limited to photon sorting methods, to chopper and reticle spatial filters and to resolution enhancement of systematic images on backgrounds of random noise. The new category of optical processing, introduced by the problem of image tube sensors operating unattended in space, is that having the function of selecting or enhancing certain systematic targets and rejecting other systematic backgrounds by virtue of geometry, color, motion and possibly polarization. . .

SIGNAL PROCESSING IN RADAR AND SONAR DIRECTIONAL SYSTEMS (With Special Reference to Systems Common to Radar, Sonar, Radio Astronomy and Ultrasonics)
J. Brit. Instn. Radio Engrs., vol. 26, no. 2, Aug. 1963, 147 p.

A symposium on the above subject, sponsored jointly by the Institution and the Electrical Engineering Department of the University of Birmingham, will be held at the University of Birmingham from 7th to 10th July 1964. . . .

NINE-CHANNEL AUTOCORRELATOR
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 33/38.

A nine-channel autocorrelator is currently being constructed for use with the planetary radar receiver located at the Venus site in Goldstone, California. This instrument is a real-time device for processing the reflected signal from a planetary surface.

DIGITAL INSTRUMENTATION SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 6/11.

. . . manufactured by Scientific Data Systems (SPS 37-16) has been installed at the Goldstone Echo Station. . . to record and log analog and digital information from the RF, servo and tracking data recording systems. . . . centers about two Scientific Data Systems computers: a 910 (Alpha computer) and 920 (Beta computer). The computers are 24-bit word, random-access, core memory machines with an 8-μsec cycle time and buffered input-output. A brief description of the function of each unit. . .

BEACON PROCESSING EQUIPMENT DESIGN STUDY
Auerbach Electronics Corp., Philadelphia, Pa., Final rept., Rept. no. 108 107 9D, June 1963, 50 p., AD 413 444.

. . . intended for inclusion in the air traffic control subsystem of the NAUS. The BPE accepts beacon video and generates a digital position and beacon code report for each target detected. . . . contains two functional units: a reply detection unit and a target detection unit. The reply detection unit senses reply code trains and generates a digital replay message containing range, azimuth and code for each target reply received on each radar sweep. The target detection unit correlates replies received on successive radar sweeps, performs target detection, determines center of azimuth, processes identity and altitude reply codes, and generates target reports. . . .

A STUDY AND INVESTIGATION OF THE OPERATIONS CENTRAL AN/MSQ-16 (XW-2)
Tridea Electronics, Inc., South Pasadena, Calif., Final rept., RADC TDR63 403, Dec. 1963, 183 p., AD 426 758.

. . . detailed requirements. . . to be installed at the Verona Test Site at the Rome Air Development Center, for the purposes of making in-flight antenna pattern measurements and to provide a general purpose facility to make spectrum signature measurements on a wide variety of radiating weapon systems. The various expected signal sources are analyzed and the required equipment performance in terms of antenna gains and receiver sensitivities is specified. . . it is concluded that an r-f differencing monopulse type tracker can provide the required angle tracking performance over the r-f tuning range of 0.1 KMc to 18 KMc . . . Transmission of signals to the main equipment location can then be made at i-f frequencies. The required signal data processing is analyzed from the standpoint of two system configurations; one employing a raw data recording system which permits data processing at any time after flight data is taken, and one employing a general-purpose digital computer for real-time data processing during the flight.

Related Publications:

ANALOG DATA HANDLING SYSTEM FOR AIRCRAFT LAUNCHING AND RECOVERY EVALUATION
J.E. Frank, Sr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p.36/48.

Design features of a semi-automatic data handling system are discussed. . . . designed for use in development and evaluation tests on aircraft-carrier-type catapult and recovery equipment at the Naval Air Test Facility (Ship Installations), Naval Air Station, Lakehurst, New Jersey. . . . methods of recording and processing the data through the utilization of highly refined FM and FM/FM multiplex techniques; and the facilities for computation and presentation of analog parameters. . . .

SIGNAL ENVIRONMENT SIMULATOR STUDY
J. R. Wolcott, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 279/281.

It was proposed to construct a simulator which could, in effect, replace a large variety of antennas employed in a receiving facility. . . . The signal output from the simulator must be as nearly like the signals from an actual antenna as possible. Signals possessing known characteristics such as azimuth, frequency, range, power output, and modulation would have to be simulated as well as alterations required to produce propagation effects and polarization if desired. . . .

SUMMARY OF THE PRELIMINARY STUDY OF THE APPLICABILITY OF THE ORDIR SYSTEM TECHNIQUES TO THE TRACKING OF PASSIVE SATELLITES
Electronics Research Labs., Columbia Univ., New York, Final rept., Rept. nos. CU2 600RD, F157, 11 Feb. 1960, 154 p., AD 419 772.

The results of a study of the problems of coherent integration and frequency estimation in a CW Doppler earth satellite tracking system are presented. . . . incorporating the coherent signal processor known as the Circulating Memory Filter (CMF) into the satellite tracking system. . . .

SCADAR
R. G. Beltzer, Bendix Systems Div., Bendix Corp., Ann Arbor, Final rept., Rept. no. BSC-30697; BSR-628, RADC TDR 62-45, Dec. 1961, lv., incl. illus., AD 274 282.

. . . new technique of data processing. . . implemented by simulation in the laboratory. . . . A working system was installed on the troposcatter DEW line training link in Illinois. . . .

OPTIMUM DETECTION OF A RADAR SIGNAL WHEN SEVERAL RECEIVING CHANNELS ARE USED
V. B. Fedorov, Radio Engng: Transl. of Radiotekhnika, vol. 17, no. 9, Sept. 1962, p. 58/66.

. . . problem of detecting, against a background of set noise and interference, a signal arriving simultaneously through several information channels of a radar system with a multilobe coverage pattern. An expression is obtained for the mutual correlation factor of interference in the individual receiving channels. It is shown that the problem of optimum reception when several information channels are used may be reduced to a problem of optimum reception according to the data of one channel by altering the magnitude of the signal and the noise level in a definite manner. . . . 3. Optimum Signal Processing. . . considers the problem of the optimum processing of a signal, taking into account the presence of K information channels, for the . . . idealized model. . . .

PULSE STRUCTURES FOR ENHANCED ACCURACY
R. K. Gardner, et al., General Atronics Corp., Conshohocken, Pa., Technical rept., GAC rept. no. 994-242-16, RADC TDR 62-179, 14 March 1962, 32 p., incl. illus., AD 276 238.

. . . a new method, called TAM (Tangent Approximating Manifold). . . which gives approximately optimum estimates of the various signal parameters. . . . applied to the measurement of target range, doppler, acceleration, and to the target multiplicity problem. . . . target simulator. . . accuracy of the TAM network can be measured. . . .

INPUT/OUTPUT EQUIPMENT FOR RESEARCH APPLICATIONS
W. S. Holmes, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 509/517.

. . . Research problems arising in the areas of photointerpretation, pattern recognition, speech analysis and radar signal analysis are described. . .

PREDETECTION RECORDING SYSTEM FOR SATURN TELEMETRY
V. A. Ratner, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 3.1, Oct. 1962.

The wide variety of telemetry links carried on the Saturn Booster (FM/FM, PCM/FM, SS/FM, PAM/FM) make acquisition and storage of telemetry data a formidable and expensive task for conventional ground stations. The versatility of predetection recording has simplified this task to the extent that all known types of modulation can be received and recorded with common equipment. The complex demodulation and demultiplexing processes are then more reasonably accomplished later at centralized computation facilities. . . .

THE ANGULAR RESOLUTION OF A RECEIVING APERTURE IN THE ABSENCE OF NOISE
V. G. Welsby, Radio Electronic Engineer, vol. 26, Aug. 1963, p. 115/124, 15 refs., A63-23677.

. . . Additive processing of the outputs of the elements of a spatial array is shown to give the best result when the field is time-stationary but unknown. More complicated processes, such as multiplication and time-averaging, have advantages either when the field is nonstationary in the time domain or when prior information about its form is available.

A REVIEW OF ANTI-CLUTTER FACILITIES FOR PRIMARY SYRVEILLANCE RADAR
L. E. Banks, In: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, p. 252/255, Collected preprints, A64-12868.

DIGITAL CIRCUIT TECHINQUES FOR SPEECH ANALYSIS
G. L. Clapper, IEEE Trans. Commun. Electronics, no. 66, May 1963, p. 296/305, 11 refs.

. . . description of an experimental word code generator developed at IBM. . . . This device produces a compressed digital code from the spoken word as a function of frequency, intensity, and time. Individual sound patterns are coded as a function of the changes in the word itself. The code is produced as the word is spoken and is displayed in matrix form for immediate analysis. Readout to a card punch or other storage media is easily accomplished.

RADAR: DETECTION, DISCRIMINATION, DECOYS AND CAMOUFLAGE: AN ANNOTATED BIBLIOGRAPHY
G. R. Evans, Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliography no. SB-61-69; Rept. no. 3-80-61-44, Sept. 1962, 80 p., 248 refs., AD 400 124.

COMPARISON OF POWER SPECTRAL DENSITY TECHNIQUES AS APPLIED TO DIGITALIZED DATA RECORDS OF NONSTATIONARY PROCESSES, PART I.
G. W. Evans, II, et al., Stanford Research Inst., Menlo Park, Calif., Technical rept. no. 14, Sept. 1963, 141 p., AD 419 493.

. . . Part II of this report. . . uses the preferred technique to analyze actual data from recordings of radar backscatter from missiles.

A PHASE-CHANNEL COMBINER, MOD. I, FOR THE NRL SPACE SURVEILLANCE SYSTEM
M. G. Kaufman, IEEE Trans. Instrum. Measurement, vol. IM-12, Dec. 1963, p. 106/119, A64-17344.

. . . for the detection of Earth satellites. The system forms a fence consisting of four receiver and three CW transmitter sites across the southern part of the U. S. . . . The CW transmitters illuminate the satellite and radio-interferometer techniques incorporated in the receivers determine the satellite's position in the east-west and north-south planes. An electronic system which automatically combines the phase channels into one unambiguous channel and depicts the angles of arrival of the radio energy from the satellites is described. The results of noise, stability, response time, sensitivity, and life tests of the phase-channel combiner are presented, and several coincidence pulse graphs are included.

A DIGITAL INTEGRATOR FOR ON-LINE SIGNAL PROCESSING (Correspondence)
Y. Lundh, IEEE Trans. Electronic Comp., vol. EC-12, no. 1, Feb. 1963, p. 26/28.

A concept for approximate digital integration is presented. The integrator is equivalent to the RC-integrator (but has no drift) and has an arbitrary long time constant.

THE AUTOMATIC SPEECH RECOGNITION SYSTEM FOR CONVERSATIONAL SOUND
T. Sakai, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 835/846.

. . . problem encountered in the automatic recognition of speech sound. . . . a mono-syllable recognition system was constructed in which the phoneme is used as the basic recognition unit. Recently this system has been developed to accept the conversational speech sound with unlimited vocabulary.

. . . also applied to the vowel recognition where the time pattern of input speech is matched with the stored standard patterns in which the phonetic contextual effects are taken into consideration. The time pattern which has great variety may be effectively expressed by the new representation of "sequential pattern" and "weighint pattern."

A MODERN TACTICAL RADAR
J. R. Vadus, Sperry Engineering Rev., vol. 16, Spring 1963, p. 2/9, A63-17580.

. . . V-beam digital data processing capabilities. . . . provide a multimission capability. . . three-dimensional sensor in an air-defense system.

DIVISION 3A.6
SIMULATION BY INFORMATION PROCESSING

The high cost of space missions in general and the complexity of space communications systems in particular make it imperative to use mathematical models and electronic simulation of their operation before accepting new designs for actual space flight.

Simulation techniques are applied in many branches of space technology. Here we are primarily concerned with those techniques which, at present, are in use in space electronics and with those which have potential applications. We exclude simulators of environmental conditions, except for those which apply information processing methods (3A.662). We include simulation methods in related areas, such as mechanical, thermal, biophysical and mental sciences, provided such methods are primarily based on information or data processing functions.

The organization of this division is straight forward. Introductory sections contain references to the art of simulation in general and to some theories and methods which apply to whole classes of simulation procedures for large scale systems. This includes the simulation of computing and control systems by computers.

Section 3A.62 deals with the simulation of electronic signal processes, including a subdivision on simulation of statistical processes in general and another subdivision on the simulation of information sources and their processing methods.

Section 3A.63 covers the wide area of simulation of electronic components and circuits, including simulation of antennas and their radiation patterns.

Of particular interest to space communications engineers is the simulation of communications links, which is discussed in section 3A.64. Subdivision 3A.642 concentrates on the simulation of channel characteristics, primarily on fading characteristics and noise. Subdivision 3A.643, under the title Simulation of Channel Operation, has direct references to the simulation of space communications links, particularly in respect to their long and fast variable range. The simulation of feedback communications links is another important item which is referenced in this subdivision.

The topological simulation and the traffic simulation of large communications networks are the subjects of section 3A.65. The ground communications network for manned space flight and deep space communications network indicate the importance of these problems in space communications systems engineering.

Finally, section 3A.66 is the section of broadest application to space technology. It begins with subdivisions for flight simulation (3A.660) and for mission simulators including orbital and rendezvous simulation (3A.661). Space environment simulation (3A.662) is restricted to subjects of interest for electronics systems engineers. The simulation of navigational operations (3A.663) is referenced on a selective basis. Active flight control simulators (3A.664) and passive flight control simulators (ATC, 3A.664) are included because of their extensive use of related electronic technologies.

The last section, 3A.68, contains references to a variety of related simulation problems which may be of interest to space communications engineers. The simulation of mental processes, in particular, has many analogies in adaptive communications processes.

Section 3A.60
Simulation Processes and Equipment

3A.600: Simulation in General

Included: Analog simulation techniques; History of computer simulation; Real time simulation; Analog-digital simulation; Simulation glossary.

Not Included: Environmental simulation laboratories.

Cross References: Computer technology in general (Div. 3A.0).

Principal Publications:

ASPECTS OF REAL-TIME SIMULATION
W. F. Bauer, IRE Trans. Electronic Comp., vol. EC-7, no. 2, June 1958, p. 134/136.

. . . Present day digital computers are too slow for the comprehensive real-time simulation of complex electronic systems such as those involving guided missiles. Computers appearing 2-3 years hence will be sufficiently fast for these applications. These are and will continue to be fertile application fields for analog-digital computer combinations. An existing large-scale (Univac Scientific 1103 A-Epsco converter—Electronic Associates) and analog-digital system is described.

ANALOG SIMULATION
W. J. Karplus, New York, McGraw-Hill Book Co., Inc., 1958, 426 p.

A BIBLIOGRAPHY ON THE USE OF SIMULATION IN MANAGEMENT ANALYSIS
D. G. Malcolm, System Development Corp., Santa Monica, Calif., Rept. no. SP-126, 10 Nov. 1959, 20 p., AD 297 442.

THE CASE FOR COMBINED ANALOG-DIGITAL SIMULATION
W. W. Varner, Western Joint Comp. Conf., 1959, p. 86/87.

SIMULATION: A SURVEY
H. H. Harman, System Development Corp., Santa Monica, Calif., Rept. no. SP-260, July 1961, 25 p., 25 refs., AD 297 448.

Current work in simulation is appraised and definitions of the word simulation are reviewed. While the Monte Carlo method represents a powerful and useful technique in simulation, it does not encompass all the legitimate scientific aspects of simulation.

SIMULATION AS A TOOL FOR RESEARCH
H. H. Harman, System Development Corp., Santa Monica, Calif., Rept. no. SP-825, 25 Sept. 1961, 5 p., AD 297 450.

FLIGHT SIMULATION OF ROCKETS AND SPACECRAFT
H. H. Hosenthien, et al., NASA, Marshall Space Flight Center, Huntsville, Ala., In its From Peenemünde to Outer Space (A Volume of Papers) Commemorating the Fiftieth Birthday of Wernher Von Braun, March 23, 1962, p. 437/469, 20 refs., N63-15996.

. . . historical viewpoint, beginning with the development of German rocketry and projecting the simulation concept into the future. . . .

TOWARD A GENERAL SIMULATION CAPABILITY
M. R. Lackner, Proc. A FIPS Spring Joint Comp. Conf., May 1962, p. 1/14.

TEN YEARS OF COMPUTER SIMULATION
J. McLeon, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 2/6.

The past and present of computer simulation are examined, and on that basis some predictions for the future are made.

REPORT ON A VISIT TO THE U.S.A. IN MARCH/APRIL 1963, TO DISCUSS PRESENT AND FUTURE SIMULATION TECHNIQUES
P. R. Benyon, Department of Supply, Australian Defense Scientific Service Weapons Research Establishment, Salisbury, South (Australia), Nov. 1963, 1 v., AD 435 576.

. . . Future simulators in the U. S. A. will probably consist of a small, fast, general purpose digital computer, a wide-bandwidth analogue computer and a flexible arrangement of digital and semi-digital building blocks for linking together the two computers and controlling the analogue computer automatically so as to make full use of its high speed.

ANALOG SIMULATION TECHNIQUES
R. A. Heartz, IEEE Spectrum, Convention Issue, March 1964, p. 221/230, 5 refs., A64-16463.

. . . use of analog simulation for analysis and solution of electronic design problems too complex for breadboards. . . .

APPLICATIONS OF SIMULATION IN COMMAND AND CONTROL SYSTEMS
M. G. Holmen, System Development Corp., Santa Monica, Calif., Rept. no. SP-1455, 5 Nov. 1963, p. 8, AD 427 817.

. . . simulation is necessary in every part of the system development process, beginning with the use of computer-operated models in the concept development stage, and leading to the regular use of simulated inputs for training procedural development, confidence testing, evaluation and system evaluation . . .

SHARE DIGITAL SIMULATION GLOSSARY
P. Kribs, System Development Corp., Santa Monica, Calif., Rept. no. SP-1562, 20 Feb. 1964, 10 p., AD 433 515.

. . . covering . . . particularly wholly computerized simulation. Analog, hybrid and real-time simulation are only cursorily mentioned.

3A.601: Theory of Simulation

Included: Simulation programs for digital computers; SIMSCRIPT; DAS; Gaming situations in real time simulation; Prediction of systems effectiveness; FAST = FORTRAN automatic symbol translator; Simulation of randomly damaged systems; Simulation of time delays.

Not Included: Decision theory (2).

Cross References: Mathematical models of large electronic systems (3A.611); Simulation of statistical processes (3A.621).

Principal Publications:

A SOLUTION TO THE EULER ANGLE TRANSFORMATION EQUATIONS
G. R. Grado, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 362/369.

As simulation studies grow more elaborate and complex, the computer operator is confronted with an ever increasing number of problems not directly associated with the study at hand. This paper describes a specially designed computer for solving the coordinate transformation equations normally encountered in a six degree of freedom simulation study.

A GENERAL SIMULATION MODEL FOR LOGISTICS OPERATION IN A RANDOMLY-DAMAGED SYSTEM
J. E. Walsh, System Development Corp., Santa Monica, Calif., Rept. no. SP-116, 10 Jan. 1960, 39 p., AD 297 444.

. . . a system in which natural attrition and induced attrition occur . . . The capability of the logistics operation is examined by simulating the operation of the entire system for a specified time period. . . . divided into subsystems and attrition is introduced by a Monte Carlo procedure.

AN ALTERNATIVE METHOD FOR OBTAINING PERFORMANCE FIGURES
M. Moll, IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 288/296.

A performance figure indicates the ability of a system to perform a task. At present, several checkout systems obtain performance figures by employing the prime equipment directly in a mission simulation. The measure-computer approach is proposed as an alternative which might sometimes be applied more advantageously. . . . the prime equipment is not directly involved in the mission simulation; hence, the simulation need not occur in real time. . . .

FAST—FORTRAN AUTOMATIC SYMBOL TRANSLATOR
MITRE Corp., Bedford, Mass., Rept. no. SR24, ESD TDR63 395, Jan. 1962, 1 v., AD 409 171.

FAST (FORTRAN Automatic Symbol Translator) is a problem-oriented language and coding system for the IBM 704, 709, or 7090 computers. It was developed at the MITRE Corporation to expedite data-analysis and simulation programming for large control systems. Its extensive use at MITRE for more than a year has proved it to be an invaluable tool for this purpose . . .

GUIDANCE TECHNIQUES STUDY, PART 3. A DIGITAL ANALOG SIMULATOR
Martin-Marietta Corp., Orlando, Fla., Final rept., 1 May-31 Oct. 1962, Nov. 1962, 20 p., AD 418 439.

DAS is a programming technique to make a digital computer operate like an analog computer. Problems are extremely easy to program (as in an analog computer) but the usual analog computer disadvantages are missing. There is no scaling or dynamic range problem. Excellent accuracy and repeatability is the rule.

ANALOG SIMULATION
R. P. Benedict, Electro-Technology (Science and Engineering Series No. 60), vol. 72, Dec. 1963, p. 73/90, 40 refs., A64-11510.

Theoretical study of analog simulation techniques. . . .

THE MAXIMUM PRINCIPLE, ITS COMPUTATIONAL ASPECTS AND ITS RELATIONS TO OTHER OPTIMIZATION TECHNIQUES
W. DeBacker, European Atomic Energy Community, Brussels (Belgium), Joint Nucl. Res. Center, Ispra Establ. (Italy), 1964, 74 p., refs., Presented at a seminar on Optimal Control, CETIS (Italy), April 1963, (EUR-590e), Available from the Belgian American Bank and Trust Co., N.Y., Account no. 12186, N64-19320.

Pontryagin's principle and its relations to the principle of optimization of Bellman, to the classical calculus of variations and to gradient methods (generalized gradient) are discussed. The synthesis of optimal systems on electronic computers is analyzed, especially those connected with the theory of penalty functions, the two-point boundary problem, parameter optimization, and sensitivity analysis. The need of hybrid computation is underlined.

ETUDE SYSTEMATIQUE DE LA GENERATION DE RETARDS AU MOYEN D'UNITES ANALOGIQUES CLASSIQUES (A Systematic Study of the Simulation of Time Delays With Standard Analogue Computer Elements)
J. Gamp, European Atomic Energy Community, Brussels, Belgium, Joint Nuclear Research Center, Ispra Establishment, Italy, Scientific Data Processing Center (Aug.) 1963, 61 p., refs., (In French), English Summary (EUR-240.f; CETIS-50), Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86, N64-11310.

A BRIEF REVIEW OF SIMSCRIPT AS A SIMULATING TECHNIQUE
M. A. Geisler, et al., RAND Corp., Santa Monica, Calif., Memo. RM3778PR, 21 p., Aug. 1963, AD 411 324, N63-19347.

. . . The method is not only an abridged language, but also a structure with the help of which a wide class of management problems can be programmed to a computer. It is so designed that whole areas of a problem can be changed without reprogramming the entire model. . . .

TECHNICAL APPENDIX ON THE SIMSCRIPT SIMULATION PROGRAMMING LANGUAGE
B. Hausner, et al., RAND Corp., Santa Monica, Calif., Memo RM3813PR, Aug. 1963, 15 p., AD 415 797.

DEVELOPMENT OF TECHNIQUES FOR PREDICTION OF SYSTEM EFFECTIVENESS
T. J. Horrigan, Cook Electric Co., Morton Grove, Ill., Final rept., RADC TDC63 407, 28 Feb. 1964, 133 p., AD 432 844.

. . . hybrid Monte-Carlo and analytical simulation programs for digital computers . . . which must be generated by the computer itself by virtue of a computer type automatic programming language. The existing languages are investigated and found unsuitable because of lack of suitable logic, protracted programming time or lack or usability by other than specially trained professional programmers. . . .

THEORY AND METHODS OF MATHEMATICAL SIMULATION
B. Y. Kogan, et al., Redstone Scientific Information Center, Redstone Arsenal, Ala., RSIC 125, 3 Feb. 1964, 6 p., AD 433 289.

. . . Analog-digital computers . . . Adaptive control systems, Digital differential analyzers.

GAMING VEHICLE FOR REAL-TIME EXPERIMENTATION
W. H. Moore, System Development Corp., Santa Monica, Calif., Rept. no. SP1405 000 00, 5 Feb. 1964, 12 p., AD 431 015.

A computer program has been developed that can produce a variety of two-person games for laboratory experimentation. The gaming situations are presented to the subject via display scopes and the subject responds by switch insertion. The computer presents the game situation to the subject, umpires the moves of the game, allows communication between subjects and provides dynamic or real-time probing of the subject as to past performance and future anticipated strategies, while recording pertinent data for future analysis. . . . used in the System Simulation Research Laboratory of System Development Corporation . . .

Related Publications:

MAKE STATISTICAL STUDIES ON ANALOG SIMULATIONS
W. E. Vander Velde, Control Engng., vol. 7, June 1960, p. 127/130.

COMPUTATIONAL ASPECTS OF APPROXIMATION THEORY
B. Boehm, RAND Corp., Santa Monica, Calif., RM-4051-PR, March 1964, 106 p., refs., AD 433 175, N64-18178.

The theory of approximation by polynomials and rational functions is of considerable practical significance, due in great part to the efficiency of polynomials and rational functions in representing functions on a high-speed digital computer . . . Topics include problems of existence, uniqueness, characterization, and error estimation of best approximations, and alogrithms for interpolation and for obtaining best least-squares and Chebyshev approximations.

3A.602: Components in Simulation Equipment

Included: Coordinate coverters in simulation equipment; Network analyzer for system simulation; Poisson cell in simulators; Time multiplexing devices in simulators.

Not Included: Multiplexing methods in communications (2).

Cross References: Digital coordinate converters (3A.440).

Principal Publications:

TIME MULTIPLEXING AS APPLIED TO ANALOG COMPUTATION
E. Rawdin, IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 42/47.

. . . can perform a common dynamic operation upon several sets of inputs utilizing equipment for one dynamic operation. . . . particularly useful to reduce the number of components required when implementing problems in a simulation laboratory.

A NEW, SOLID-STATE, NONLINEAR ANALOG COMPONENT
L. D. Kovach, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 496/503.

. . . a passive, nonlinear device which, when used with operational amplifiers, provides the means for obtaining a large class of functions. . . .

ANALOG REPRESENTATION OF POISSON'S EQUATION IN TWO DIMENSIONS
R. J. Martin, et al., IRE Trans. Electronic Comp., vol. EC-9, no. 4, Dec. 1960, p. 490/496.

A new analog device, called a Poisson cell, has been developed . . . The cell may be used to simulate such potentials as electric potential, magnetic potential, gravitational potential, and the velocity potential of irrotational flow; it has applications in the fields of hydrodynamics, heat conduction, and aerodynamics. The cell is a solid volume-conducting medium made from a homogeneous mixture of hydrostone and graphite. Electrode configurations may be painted on the surface with conducting paint or imbedded directly in the structure.

THE LIMITATIONS OF RC LADDER NETWORKS AS PROCESS SIMULATORS
N. Ream, Proc. Instn. Elect. Engrs., Pt. B, vol. 109, no. 48, Nov. 1962, p. 529/536.

A definition of controllability in terms of the attenuation/phase relationship at zero frequency is used to derive a formula for the controllability of an n-stage RC ladder network. . . .

A MECHANICAL ANALOG SIMULATOR FOR CONVERTING HYPERBOLIC COORDINATES INTO RECTANGULAR COORDINATES
J. D. N. van Wyk, et al., IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 3, Sept. 1962, p. 145/150.

. . . for a short-range hyperbolic position-fixing system . . . The instrument caters for a range of about 40 km and a design accuracy of 0.5 per cent. . . .

FUNCTION MODELING EXPERIMENTS
R. O. Duda, et al., Stanford Research Inst., Menlo Park, Calif., Technical rept., Dec. 1963, 67 p., AD 427 018.

. . . capabilities and the limitations of trainable machines for use in function modeling . . . Viewed as a statistical procedure, this technique is essentially a non parametric procedure that can be efficiently performed by a special purpose computer of the type currently being constructed for pattern recognition problems . . .

NETWORK ANALYZER FOR SYSTEM SIMULATION
J. M. Spurlock, et al., Electro-Technology, vol. 73, March 1964, p. 126/127, 12 refs., A64-16053.

. . . design and applications of a portable, passive-element network analyzer used in the simulation, analysis, and design of complex aerospace systems. When programmed, the analyzer becomes an electric model of a physical system . . .

Related Publications:

A NEW FUNCTION GENERATOR
C. W. Eggers, et al., Commun. and Electronics, vol. 79, no. 52, Jan. 1961, p. 756/762, 14 refs.

In analog computing technology as well as in the laboratory study of control instrumentation or simulation systems, it is frequently desirable to be able to provide a given arbitrary periodic function as a forcing function. . . .

A TRANSPORTATION LAG CIRCUIT FOR ANALOGUE COMPUTATION
R. E. King, J. Brit. Instn. Radio Engrs., vol. 24, no. 2, Aug. 1962, p. 111/115.

. . . In simulating physical processes on electronic analogue computers it is often therefore necessary to incorporate . . . transportation lags. . . .

A METHOD OF GENERATING FUNCTIONS OF SEVERAL VARIABLES USING ANALOG DIODE LOGIC
R. H. Wilkinson, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 112/129.

. . . polyhedral model is generated directly by the circuit. . . . circuit is formed of two cascaded sections: the first, using resistive networks, generates voltages representing each of the faces of the polyhedron; the second section, using analog diode logic, selects the appropriate voltage as the output.

3A.603: Simulation Equipment

Included: Polinom, a USSR simulator; PPM analog computer as simulator; Analog-digital computer as simulator; Digital simulation equipment; Real time simulation equipment.

Cross References: Hybrid computation in general (3A.004); Analog-digital information processing methods (Div. 3A.5); Digital information processing methods (Div. 3A.4).

Principal Publications:

A HIGH-SPEED ANALOG-DIGITAL COMPUTER FOR SIMULATION
R. C. Lee, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 186/196.

. . . capable of simulating complex physical systems in real time. Information in the machine is represented by an analog voltage pulse and a digital number. Arithmetic operations are performed in time-shared analog computing components and conventional digital logical elements. A novel floating-point arithmetic feature is provided to extend the dynamic range of the machine variables.

A PULSE POSITION MODULATION ANALOG COMPUTER
E. V. Bohn, IRE Trans. Electronic Comp., vol. EC-9, no. 2, June 1960, p. 256/261.

An important field of application for computers is in real-time system simulation. This requires the generation of nonlinear functions, obtaining the sums and products of these functions and solving systems of nonlinear differential equations. A new type of analog computer . . . is described . . . Variables are represented by the time interval between pulses. Utilizing a few basic components, it is possible to carry out the operations of addition, subtraction, multiplication and function generation to 0.1 per cent accuracy.

"POLINOM" SPECIAL-PURPOSE ELECTRONIC-RELAY DIGITAL SIMULATOR
G. G. Men'shikov, et al., Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 10, 1961, p. 61/70.

. . . designed for computing the functional series of a wide class of functions encountered in radio engineering practice. . . . simplicity of the setup procedure, the relative simplicity of equipment, ease of insertion of information and certain other advantages . . .

ANALOG-DIGITAL COMPUTERS FOR REAL-TIME SIMULATION
M. E. Connelly, Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab., Technical Report, Feb. 19, 1962, 121 p., 55 refs., N63-20964.

. . . concluded that the use of peripheral pulsed-analog equipment would increase the effective computing speed of a given digital computer on simulation problems by a factor of two or more.

HIGH SPEED DIGITAL EQUIPMENT FOR SST AND SPACE SIMULATORS
J. M. Hunt, American Society of Mechanical Engineers, Aviation and Space, Hydraulic, and Gas Turbine Conference and Products Show, Los Angeles, Calif., 3-7 March 1963, Paper 63-AH GT-80, 8 p., A63-17578.

. . . evaluating the required computational speed of digital computers in their substitution for analog computation in complex real-time simulation.

EVALUATION OF THE AN/SPS-T2A SIMULATOR
Army Air Defense Board, Fort Bliss, Texas, 27 March 1963, 1 v., AD 417 291.

. . . In its present form the AN/SPS-T2(A) incompatible with complete system simulation concepts, because it is usable to program exercise the entire air defense artillery complex. . . . presently unsuitable for Army-wide use. . . .

Related Publications:

THE ALPAK SYSTEM FOR NONNUMERICAL ALGEBRA ON A DIGITAL COMPUTER—I: POLYNOMIALS IN SEVERAL VARIABLES AND TRUNCATED POWER SERIES WITH POLYNOMIAL COEFFICIENTS
W. S. Brown, Bell Syst. Tech. J., vol. 42. no. 5, Sept. 1963, p. 2081/2119.

. . . The ALPAK system has been programmed within the BE-SYS-4 monitor system on the IBM 7090 computer, but the language and concepts are machine independent.

The available polynomial arithmetic operations are add, subtract, multiply, divide (if divisible), substitute, differentiate, zero test, nonzero test, and equality test. . . .

. . . nontechnical description . . . glimpse into the future . . . specific problems . . .

Section 3A.61
Simulation Methods for Large Systems and Organizations

3A.611: Mathematical Simulation Models

Included: Error propagation in large systems; Simulation of polystable systems; System modeling techniques; Mathematical models for the simulation of nonlinear systems; Linear system approximation for the simulation of nonlinear systems; Electronic modeling; Planning of systems.

Not Included: Systems engineering; Theory of electronic systems in general.

Cross References: Theory of simulation (3A.601).

Principal Publications:

LINEAR SYSTEM APPROXIMATION BY DIFFERENTIAL ANALYZER SIMULATION OF ORTHONORMAL APPROXIMATION FUNCTIONS
E. G. Gilbert, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 204/209.

. . . In the procedure developed in this paper, a group of N linear approximating systems with orthonormal impulse responses $\emptyset_n(t)$ are realized by operational amplifier circuits. Several approximation examples are given.

INITIAL CONDITIONS IN COMPUTER SIMULATION
K. S. Miller, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 1, March 1961, p. 78/80.

A technique is developed for the straightforward simulation of the transfer function of a certain class of linear systems. This method is particularly well adapted to the analysis of systems with fixed transfer function and variable initial conditions and forcing functions.

ON FOURTH-ORDER SIMULATION BY ONE AMPLIFIER
G. K. Aggarwal, J. Electronics and Control, vol. 15, Nov. 1963, p. 449/468, A64-11797.

Analysis of circuits for simulating fourth-order linear systems through the use of a single operational amplifier. Considered are ten alternative circuits. . . .

RESEARCH DIRECTORATE REPORT. LANGUAGE AND INFORMATION PROCESSING. INFORMATION RETRIEVAL STUDIES AND LINGUISTICS
L. F. Carter, et al., System Development Corp., Santa Monica, Calif., TM-530/007/00, Jan. 1964, 101 p., refs., N64-16257.

. . . covers discussions on . . . systems simulation . . .

SOME CONSIDERATIONS OF POLYSTABLE SYSTEMS
H. S. Fitzhugh, II, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 213/220.

. . . simulation on a large-scale computer. . . . to investigate the behavior of such systems as a function of the characteristics of the individual parts making up the system and the way in which the parts are joined together. A variety of behaviors has been observed by varying these two parameters for various input conditions. . . .

ERROR PROPAGATION
J. N. Jamieson, Radio Corp. of America, Patrick AFB, Fla., In AF Missile Test Center New Data Reduction Methods to Improve Range Data, 1963, p. 7/16, N64-15313.

The random errors known to exist in a measuring device are propagated through the mathematical model of the device to the final measurements, so that estimates of the errors in the data to be expected can be obtained when future measurements are taken. This is commonly referred to a geometric dilution of precision (GDOP). A description of the theory and the methods of computation are given.

PLANNING OF SYSTEMS
L. K. Kirchmayer, IEEE Trans. Mil. Electronics, vol. MIL-8, no. 2, April 1964, p. 54/58.

The methodology of planning systems to meet stated goals in an optimum manner while recognizing all pertinent constraints is being given increasing attention by systems engineers. . . . Significant progress in system planning has been achieved to date in the electric utility industry. Integrated digital computer programs have been devised which permit the modeling of the technical and economic performance of future system design alternatives and aid the system planner is obtaining an optimum total system beginning with the sources of fuel and ending with the final delivery of power to the customer. . . .

A METHOD FOR THE DETERMINATION OF A DIFFERENTIAL EQUATION MODEL FOR SIMPLE NONLINEAR SYSTEMS
R. H. Kohr, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 294/400.

A method is described for the establishment of a nonlinear differential equation which acts as a model for an actual physical system. It is assumed initially that the actual system contains only a single nonlinear element and that this element may be represented in the differential equation model by a single-valued nonlinear function of a single variable. The method is then extended to systems which contain several nonlinear elements.

MATHEMATICAL MODELS FOR SYSTEM ANALYSIS
L. D. Krull, Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, Aug. 1963, 31 p., AD 419 609.

. . . The modeling of systems which can be considered stochastic in nature has wide application for system analysis. . . . system . . . made up of operational units and repair channels, having respectively, time dependent failure rates and time dependent repair rates . . . model . . . written as a differential equation. . . . use of . . . analog simulation . . .

INVESTIGATION ON AN ELECTRONIC COMPUTER OF CONTINUOUS MODELS OF CONTROL SYSTEMS
I. P. Lukashevich, Joint Publications Research Service, Washington, D. C., JPRS-23864; OTS-64-21892, 25 March 1964, 12 p., refs., Transl. into English from Biofizika (Moscow), v. 8, no. 6, 1963, p. 715/721, N64-17712.

. . . mathematical model that is a discrete analog of a continuous control system. The model is a medium in which every point is capable of excitation . . . The medium consists of identical elements, identically united among themselves . . .

A STUDY OF SYSTEM MODELING TECHNIQUES
S. B. Rosen, et al., General Electric Co., Washington, D. C., Final Report, ESD TDR63 612, Oct. 1963, 1 v., AD 424 561.

. . . to ascertain the suitability of the General Electric modeling technique to describe complex Air Force Command and Control Systems. The 473L, BMEWS, and 412L Systems were modeled with emphasis on timing and accuracy applications. . . .

ELECTRONIC MODELING
Joint Publications Research Service, Washington, D. C., JPRS-19563; OTS-63-21983, 5 June 1963, 15 p., refs., Transl. into English of two articles from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 4, 1963, p. 447/451; 451/453, N64-10831.

. . . modeling differential equations with boundary conditions on an analog computer . . . applied to girder systems . . . realization of the Piccard method . . .

Related Publications:

REAL-TIME ANALOG-DIGITAL COMPUTATION
M. E. Connelly, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 31/41.

. . . hybrid configuration is suggested consisting of a basic digital computer and peripheral, high-speed analog elements used on a time-shared basis under the control of the digital program. Programs for function generation and for the solution of the aircraft roll equation are presented to illustrate the operation of the hybrid computer . . .

FIRST CONGRESS ON THE INFORMATION SYSTEM SCIENCES SESSION 7. INFORMATION SYSTEM SIMULATION AND MODELLING TECHNIQUES
Mitre Corp., Bedford, Mass., Rept. no. SS7, ESD TDR63 474 7, Dec. 1963, 108 p., AD 426 985.

The Leviathan project is a unique, experimental approach to studying the structure and social dynamics of large-scale organizations such as a military command, a government bureau, or an industrial organization . . . Three simulations are discussed in the paper: an automatic-mode simulation, a live simulation, and a dual-mode simulation . . .

3A.612: Simulation of Computing Systems

Included: Computers as simulating computers; Simulation of large DP systems; Testing of computer logic by simulation; Analog simulation of digital computer programs; DEPI, a code to simulate an analog computer on a digital machine.

Cross References: Simulation of electronic circuits (3A.630); Computer systems organization (3A.130).

Principal Publications:

DIGITAL SIMULATION OF A WEAPONS SYSTEMS DIGITAL CONTROL COMPUTER
W. B. Fritz, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 272/278.

. . . necessary . . . to parallel the development of the weapon system . . . Details of a simulation (written for the IBM 704) of a large scale digital computer to be used with a complex missile ground control system are provided. . .

A COMPARISON OF COMPUTERS
F. G. Curl, Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 542/547.

A routine simulating the operation of an analog computer was constructed for use on a digital computer at the Jet Propulsion Laboratory. This code, called DEPI, as an abbreviation for "differential equations pseudo-code interpreter," provides much of the flexibility and ease of operation associated with analog computer operation. . . .

RESULTS OF SIMULATION COMPARISON OF CONTROL COMPUTERS
G. T. Sendzuk, Commun. and Electronics vol. 80, no. 57, Nov. 1961, p. 547/550.

. . . a comparison of digital computers by simulation techniques was made by programming the operation of both incremental and whole-number machines on a general-purpose computer. . . .

A MONTE CARLO SIMULATION OF THE SACCS DATA PROCESSING CENTRAL
M. I. Gang, System Development Corp., Santa Monica, Calif., Rept. no. SP-825, 18 June 1962, 47 p., incl. illus., tables, AD 297 453.

ANALOG SIMULATION OF DIGITAL COMPUTER PROGRAMS
R. Saucedo, et al., Commun. and Electronics, vol. 80, no. 58, Jan. 1962, p. 703/709.

. . . to reduce the concept of a digital computer program to an analogous sampled-data control system, which can then be studied and analyzed by established theories and simulated on an analog computer. . . .

COMPUTER SIMULATION OF A DATA COMPRESSOR FOR AEROSPACE TELEMETRY SYSTEMS
R. A. Schomburg, Rec. Nat. Symp. Space Electronics Telemetry, no. 4.2, Oct. 1962.

. . . investigated the feasibility and effectiveness of a telemetry data compression technique by means of digital computer simulation, using actual satellite vehicle flight telemetry data as the input to the simulated data compressor. With this particular technique, a data sample is transmitted only if it has changed by more than a preset limit from the last sample transmitted. . . . compression ratios ranging from 27 to 39 were obtained for the orbital data, and a compression ratio of 19 was obtained for the launch data. In contrast, vibration data used in the study exhibited an average compression ratio of only 2 . . .

COMPUTER LOGIC TESTING BY SIMULATION
G. N. Stockwell, IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 275/282.

. . . This paper describes one such method which utilizes an IBM 704 to simulate the logical equivalent of a specific computer under development by Nortronics Division of Northrop Corporation.
. . . eliminates much of the expensive checkout time usually required. . . .

CONTENT-ADDRESSABLE MEMORY SYSTEMS
R. H. Fuller, California U., Los Angeles, Rept. no. 63 25, June 1963, 549 p., AD 417 644.

. . . A simulation package is developed which allows simulation of CAM commands within job programs run on the IBM 7090 and derives tallies of execution times corresponding to a particular realization of a CAM system.

Related Publications:

RANGE-ONLY TARGET CORRELATION
D. F. Allen, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 430/436.

. . . State-of-the-art digital logic and a limited stored program computer can be specified for real-time correlation in presently realizable radar systems. . . . The Range-Only Target Correlator has been successfully simulated on the IBM 704 computer. . . .

3A.613: Simulation of Control Systems

Included: Simulation for the design of automatic control systems; Simulation of sampled data control systems; Simulation in linear pulse systems.

Not Included: Sampled data systems for communications (1).

Cross References: Sampled information processing techniques (Sect. 3A.55).

Principal Publications:

OPTIMIZATION BY RANDOM SEARCH ON THE ANALOG COMPUTER
J. K. Munson, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 200/203.

One method of searching a system for optimum operating conditions is to evaluate system performance for many randomly-chosen combinations of the independent parameters. This paper explains the use of standard electronic analog computer equipment to accomplish such a search of a mathematical model quickly and economically. Gaussian noise sources generate values of the independent parameters and sample-hold circuits hold those values which give the best value of the optimization criterion.

APPLICATION OF SIMULATION IN ANALYZING LINEAR PULSE SYSTEMS WITH VARIABLE PARAMETERS
G. P. Tartakovskii, Autom. Remote Control, vol. 20, May 1959, p. 559/566.

ELECTRONIC SIMULATION AND COMPUTER TECHNIQUES IN THE DESIGN OF AUTOMATIC CONTROL SYSTEMS
C. Snowdon, J. Brit. Instn. Radio Engrs., vol. 21, no. 4, April 1961, p. 323/333.

. . . for the development of aircraft automatic control systems . . . commence with a completely theoretical investigation on an analogue computer, thence by the introduction of more and more actual components to a complete simulator. . . .

DESIGN OF AN ACCURATE SIMULATOR FOR SAMPLED-DATA SYSTEMS
M. J. Somerville, et al., Proc. Instn. Elec. Engrs., Pt. B, vol. 109, no. 43, Jan. 1962, p. 67/76.

. . . detailed consideration . . . certain specialized units by means of which an analogue machine, normally used for simulation of continuous systems, may be adapted to allow also simulation of sampled-data systems. . . .

REMOTE STEERING OF A LUNAR SURFACE VEHICLE
G. M. Jordan, et al., Navigation, vol. 10, Autumn 1963, p. 230/241, A64-10454.

Analysis and selection of an optimum steering system for the remote control of a mobile lunar surface vehicle. Combinations of three steering configurations and three types of controllers are considered as possible steering systems. The generalized system concept is developed, and an analog-computer simulation is described. . . .

INVESTIGATION OF CONTINUOUS MODELS OF CONTROL SYSTEMS ON ELECTRONIC COMPUTER
I. P. Lukashevich, Joint Publications Research Service, Washington, D. C., In its Study of DNA Mol. Flexibility and Continuous Models of Excitable Media, 20 April 1964, p. 11/20, refs., N64-19784.

A mathematical model representing a discrete analog of an excitable homogeneous medium is described. The medium consists of identical elements connected identically with one another, i.e.: (1) Every point of the medium is capable of excitation that is instantaneous. (2) Excitation can spread in the medium. (3) Each point is capable of spontaneous activity. Results are discussed of a number of experiments in which the model was used.

A SIMULATION MODEL OF AN INERTIAL GUIDANCE SYSTEM REPAIR SHOP: A PLANNING TOOL
R. C. Steorts, RAND Corp., Santa Monica, Calif., Rept. no. RM3599PR, March 1964, 112 p., AD 433 176.

Related Publications:

EXTENDED SYNTHESIS TECHNIQUES FOR MULTIPOLE SAMPLED-DATA CONTROL SYSTEMS
E. B. Stear, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 299/309.

. . . presentation of a logical and efficient procedure for the synthesis of multipole sampled-data control systems. It is assumed that the specifications on the system are stated in the time domain . . . In addition to this, a lower bound is established for the sampling rate based on system requirements. . . .

SYNTHESIS OF NONLINEAR DIGITAL CONTROL SYSTEMS
Y. Fujimoto, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 1, Jan. 1963, p. 61/69.

. . . The use of a digital computer allows this technique to carry out the design of the optimum system. . . .

Section 3A. 62
Simulation of Electronic Signal Processes

3A. 620: Simulation of Telemetry Signals

Included: Simulation of telemetry data; TLM computer data.

Not Included: Space telemetry equipment; Modulation methods for telemetry (1).

Cross References: Simulation of space communications links (3A. 643).

Principal Publications:

SPECIFICATIONS FOR THE SIMULATION OF TELEMETRY DATA AS AN INPUT FROM THE TDP TO THE TLM COMPUTER AT THE REMOTE TRACKING STATION (MILESTONE 3 & 4 COMBINED)
J. Ng, System Development Corp., Santa Monica, Calif., Technical memo no. TM-(L)-734/034/00, 26 Feb. 1963, 13 p., AD 298 193

COMPUTER OPERATING INSTRUCTIONS FOR THE SYSTEM SIMULATED TELEMETRY DATA GENERATION PROGRAM (STSTLM) MILESTONE 7
J. Ng, System Development Corp., Santa Monica, Calif., Rept. no. TM-(L)-734/035/00, 22 March 1963, 16 p., AD 402 198.

. . . has been designed to generate a simulated tape (TLM-tape) containing input data for the TLM computer at the tracking station. . . . will also generate the System Time Code Word (STCW) and the Input Control Word in exactly the same format as they are normally input to the TLM computer.

1604 SIMULATION PROGRAM DESCRIPTIONS MILESTONE XI, THE SIMULATED TELEMETRY DATA GENERATION CONTROL PROGRAM (STGR)
J. Ng, System Development Corp., Santa Monica, Calif., TM L734 024 00, 15 March 1963, 31 p., AD 405 132.

. . . designed to provide realistic telemetry data (Fixed Format and Event Items) under card input control. The simulated data will be packed in the same format as the Telemetry Report Message (Message Type #13). In the present version, only the FM/FM telemetry data is simulated. Additional capability to simulate PAM and PCM telemetry data (exclusive of special vehicle-specific payload telemetry) will be incorporated . . .

1604 SIMULATION PROGRAM DESCRIPTIONS MILESTONE 11, THE SIMULATED TELEMETRY DATA GENERATION PROGRAM (STSSLM)
J. Ng, System Development Corp., Santa Monica, Calif., TM L734 036 00, 1 April 1963, 29 p., AD 405 388.

SPECIFICATION FOR THE SIMULATION OF TELEMETRY DATA AS AN INPUT FROM THE TDP TO THE TLM COMPUTER AT THE REMOTE TRACKING STATION (MILESTONE 3 AND 4 COMBINED)
J. Ng, System Development Corp., Santa Monica, Calif., TM L734 034 01, 30 April 1963, 31 p., AD 405 700.

A simulation method which will provide simulated telemetry data as an input, in digital form, to the TLM (telemetry) computer at the remote tracking station . . . generated by a 1604 computer . . . for use in either a "real time" mode or "Post-pass playback" mode.

COMPUTER OPERATING INSTRUCTIONS FOR THE SIMULATED TELEMETRY DATA GENERATION PROGRAM (STSTLM) MILESTONE 7
J. Ng, System Development Corp., Santa Monica, Calif., TM734 035 01, 6 June 1963, 58 p., AD 411 645.

. . . designed to generate a simulated tape (TLM-tape) containing input data for the TLM computer at the tracking station. The STSTLM program will also generate the system time code word (STCW) and the Input Control Word in exactly the same format as they are normally input to the TLM computer.

3A. 621: Simulation of Statistical Processes

Included: Monte-Carlo methods in simulation processes; Arithmetic simulation of random processes; Linearized nonlinear regression; Random time histories.

Not Included: Analysis of random processes (1); Statistical analysis of noise in communications channels (1).

Cross References: Random process generation (3A. 420).

Principal Publications:

USE OF LINEARIZED NONLINEAR REGRESSION FOR SIMULATIONS INVOLVING MONTE CARLO
J. E. Walsh, System Development Corp., Santa Monica, Calif., Rept. no. SP-487, 3 May 1962, 14 p., 3 refs., AD 297 441.

Presents a linearized nonlinear regression method which has substantial curve-fitting flexibility . . . Outlines some nonprobabilistic curve-fitting procedures for determining a regression function.

ALLGEMEINE EINFUHRUNG IN DIE MONTE-CARLO-METHODEN (General Introduction To Monte Carlo Methods) (In German)
F. Hammelrath, In Wiss. Ges. fur Luft- und Raumfahrt, Operations Res. in Air- and Space-Travel, 1963, p. 5/13, refs., N 64-11864.

. . . Monte Carlo methods are those by which a stated problem is modeled according to suitable random processes . . . are valuable in investigating random processes, since such processes lead to such involved mathematical problems that simulation is the only solution . . . however, it appears that, only in rare cases, do they offer an advantage over the classical approximation methods.

SIMULATION USING THE MONTE CARLO METHOD
R. F. Iuorno, Rome Air Development Center, Griffiss Air Force Base, N. Y., RADC RAW TM 63 5, May 1963, 25 p., AD 410 290.

. . . problem of communications in a jamming environment is used to illustrate the use of the Monte Carlo method. Two mathematical models, each representing a different jamming communication configuration, are constructed and solved using the Monte Carlo method . . .

TECHNIQUES FOR EXAMINING THE STATISTICAL AND POWER SPECTRAL PROPERTIES OF RANDOM TIME HISTORIES
H. A. Leybold, Virginia Polytechnic Inst., Blacksburg, May 1963, 69 p., 29 refs., N63-16730.

A technique for digitally generating random time histories having arbitrarily shaped power spectra is presented. . . .

ARITHMETIC SIMULATION OF RANDOM PROCESSES
A. G. Postnikov, Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio, 4 June 1963, 98 p., AD 414 717.

OPTIMIZING STATISTICAL ANALYSIS: DATA SCREENING AND PRECONDITIONING
A. J. Scott, Northwestern Univ., Evanston, Ill., TR7, Feb. 1964, 47 p., AD 433 551.

Related Publications:

RELIABILITY MONITORING BY OPTIONAL STOPPING SAMPLING
N. R. Garner, In Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C., Papers presented at the Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18-21 June 1962, p. 441/446, 3 refs., N63-17299.

. . . This procedure allows testing to continue until k defects are observed. At this time one of these decisions are made. If the number of trials is too small, testing is stopped and an engineering change is required. If the number of trials is too large, then a new reliability plateau has been achieved. If the number of runs is neither too small nor too large, a new sequence of testing begins. . . . The mathematical model is discussed, cumulative probabilities are given so that control charts can be established, and an example is presented. This method may find application in adaptive communications systems.

Principal Publications:

DESCRIPTION AND RESULTS OF EXPERIMENTS WITH SPEECH USING DIGITAL COMPUTER SIMULATION
E. E. David, Jr., et al., Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 766/775.

Research in the efficient coding of speech often necessitates building extensive operating models to obtain subjective evaluations of performance. This paper discusses digital simulation of such models on general-purpose computers using actual speech.

IMAGE SIMULATION AND INTERPRETATION
G. L. Meyer, Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 335/345.

3A.622: Simulation of Information Sources

Included: Simulation of compaction processes of the input information; Pattern association in simulation; Image simulation; Speech simulation; Simulation of vocoder.

Not Included: Statistical characteristics of information sources (2); Pattern recognition methods (2); Data compaction methods (2); Vocoder methods (2).

Cross References: Speech signal processing by computers (3A.570).

. . . Two experiments were conducted to find out what the relation is between the quality of the image and the quality of the information that can be extracted from it. An image simulator was constructed to produce imagery that could be used with trained photo-interpreters in the experiments . . . Much work in evaluation still remains to be done, especially in the areas of subjective analysis as opposed to form recognition.

CORRELATION TECHNIQUES FOR SPEECH BANDWIDTH COMPRESSION
M. R. Schroeder, J. Audio Engng. Soc., vol. 10, no. 2, April 1962, p. 163/166.

. . . Both autocorrelation and cross-correlation vocoders were simulated on a digital computer (IBM 7090) using special programming techniques. The remade speech quality was judged superior or equal to the best known spectrum channel vocoders for comparable bandwidth, bandwidth compression, and synthesizer excitation.

A CONSISTENCY TECHNIQUE FOR PATTERN ASSOCIATION
J. R. Ullmann, IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. S75/81.

A new technique based on the consistency of partial classifications is compared with other techniques for pattern association in the light of computer simulations and other considerations. . . .

A RESEARCH STUDY OF IMPROVED CODING FOR MILITARY DIGITAL TELEVISION
R. Van Blerkom, et al., IBM Federal Systems Div., Rockville, Md., Quarterly rept. no. 1, 1 March-1 June 1962, Rept. no. 2, 1 June 1962, 1 v., incl. illus., 29 refs., AD 282 855.

. . . to obtain more efficient digital television systems applied to intercommunications (video telephone), briefing, and observing hazardous operations. . . . simulation on an IBM 709 computer. Several methods are presented for representing a single frame of a television picture and a discussion of computer programs for simulating these processes in non-real-time is included. Experimental results of two-dimensional processes are given and pertinent psycho-physical effects are discussed.

THE PRODUCTION OF RANDOMLY DISTORTED AND DETERIORATED PATTERNS
R. E. Manelis, Air Force Special Weapons Center, Kirtland AFB, N. Mex., AFSWC TDR63 44, 11 April 1963, 23 p., AD 405 587.

A set of computer subroutines which attempt to simulate various degrees of distortion and deterioration on an input character . . . A complete set of the letters of the Cyrillic alphabet, numerals, and some punctuation were quantized and punched to be used as ideal input characters to transforming subroutines.

Related Publications:

CHARACTER RECOGNITION BY DIGITAL FEATURE DETECTION
I. H. Sublette, et al., RCA Rev., vol. 23, no. 1, March 1962, p. 60/79.

. . . The effectiveness of these techniques has been tested by simulating them on a general-purpose computer . . .

Section 3A.63

3A.630: Simulation of Electronic Circuits and Components

Included: Simulation of secondary power subsystems; Simulation of filters; Simulation for reliability predictions; Simulation of decision systems; Simulation of decoding systems; Simulation of antenna systems and arrays; SPEED concept; Simulation of magnetic characteristics; Simulation of magnetic components; Removing arcs from a network by simulation.

Not Included: Design of space craft auxiliary power supply systems; Filter design; Reliability theory and practice; Decision theory (2).

Cross References: Digital filters (3A.432); Reliability of information processing equipment (3A.162); Signal processing subsystems (3A.580); Digital code converters (3A.440).

Principal Publications:

ON THE LOOP- AND NODE-ANALYSIS APPROACHES TO THE SIMULATION OF ELECTRICAL NETWORKS
J. Otterman, IRE Trans. Electronic Comp., vol. EC-7, no. 3, Sept. 1958, p. 199/206.

The number of integrators in an analog-computer setup should be equal to the order of the differential equation describing the system. This paper presents a new procedure for tracing the loop currents which results in one-to-one correspondence between the number of integrators in the stimulation setup and the count of independent energy-storing elements in the network, i.e., the degree of the system's characteristic equation.

AN IDEAL IDENTIFICATION DEVICE FOR COMPLEX SIGNALS
L. F. Borodin, Radio Engng: Transl. of Radiotekhnika, vol. 15, no. 8, 1960, p. 60/74.

. . . an identification device which for a given receiver will ensure the maximum probability of correct reception of the combinations in a correcting code. It is shown that the use of this ideal device and "equidistant" codes makes it possible to transmit messages along channels with the desired degree of authenticity. The possibility of correcting errors by arithmetic operations is indicated. The results are given of an experiment carried out on a high-speed electronic computer to compare a number of other methods of reception with the ideal method. The results of the experiment confirm that the "symbol" method of reception is imperfect. . . .

THE EXISTENCE OF AN ELECTRIC ANALOG OF A MAGNETIC CIRCUIT ESTABLISHED BY THE BASIC LAWS DEFINING MAGNETOSTATICS
E. C. Koenig, Commun. and Electronics, vol. 79, no. 50, Sept. 1960, p. 400/403.

CIRCUITS EMPLOYING TOROIDAL MAGNETIC CORES AS ANALOGS OF MULTIPATH CORES
J. A. Baldwin, Jr., IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 218/223.

. . . The conservation of flux at a node is simulated by means of shorted windings connecting groups of cores. These insure that the sum of the flux changes in the cores on a given winding will vanish. Ampere's law is simulated by proper choice of both number of turns and core dimensions.

SIMULATION OF DECISION SYSTEMS, PAPERS AND NOTES
C. M. Festa, et al., Mitre Corp., Bedford, Mass., Rept. no. SR48, ESD TDR63 424, 54 p., Jan. 1962, AD 410 267.

ANALOG-COMPUTER SIMULATION OF A FREQUENCY DETECTOR (Correspondence)
E. W. Henry, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 80.

The basic circuit, which requires only five operational amplifiers, produces a dc output voltage which is proportional to the frequency of zero-crossings of the input signal. Two additional amplifiers with associated diodes are used to shape the detector characteristic.

INHIBITED ERROR-CORRECTION DECODER PERFORMANCE
M. E. Mitchell, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 425/435.

. . . An "inhibited" error-correction decoder is defined as one which inhibits its output of decoded information bits when an uncorrectable error is detected. . . . the effect of such errors on several error-correction decoders of practical interest is described in terms of the numerical results of a computer simulation. . . .

DIFAIR, AN ADJUSTABLE DIGITAL FILTER
C.N. Pryor, Naval Ordinance Lab., White Oak, Md., Rept. no. NOLTR 62-171, 27 Sept. 1962, 9 p., illus., tables, 2 refs., AD 297 400.

. . . present device simulates such filters of the convolution integral once the desired impulse response is set into the selector switches.

THE APPLICATION OF NETWORK ANALYSIS TO THE RESISTANCE NETWORK ANALOGUE AND TO RELAXATION PROCEDURES
K. F. Sander, Proc. Instn. Elect. Engrs., Pt. C, vol. 109, no. 16, Sept. 1962, p. 516/526.

Networks used as practical aids to solving Laplace's equation are considered from the aspect of circuit theory. The possibilities of economy in network size and exact simulation of truly infinite networks are pointed out. Calculations are presented for certain common network configurations, principally corresponding to 2-dimensional problems. . . .

MARINER R-SECONDARY POWER
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 22/25.

. . . designed to be a general purpose tool for simulating power system component operation and interaction. . . .

AN INVESTIGATION OF THE FANO SEQUENTIAL DECODING ALGORITHM BY COMPUTER SIMULATION
G. Blustein, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 62G5, AFESD TDR 63 88, 12 July 1963, 35 p., AD 412 632.

. . . A computer program (FSD) for executing the algorithm on a simulated binary symmetric channel is discussed and certain results . . . are reported. . . .

COMMENTS ON "ANALOG COMPUTER SIMULATION OF A FREQUENCY DETECTOR" (Correspondence)
A. Bridgman, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 911.

DIGITAL COMPUTER TECHNIQUES FOR DETERMINING CIRCUIT BEHAVIOR IN A PULSED NUCLEAR ENVIRONMENT
W. E. Craig, et al., IEEE Trans. Nuclear Sci., vol. NS-10, Nov. 1963, p. 168/176, A64-11909.

. . . two digital computer circuit analysis programs which predict circuit response in a pulsed nuclear radiation environment. One program requires that linear direct current equations be written manually and then programmed for computer solution. The other program generates the equations from topological circuit information and then solves the equations during the radiation burst automatically. . . .

ANALOG COMPUTER SIMULATION OF THE DYNA-SOAR GLIDER INTEGRATED ENVIRONMENTAL CONTROL AND SECONDARY POWER SUBSYSTEMS
E.W. Cravens, et al., Boeing Co., Seattle, Wash., 29 March 1963, 315 p., 1 v., and 145 p., AD 433 561, AD 433 563, and AD 433 564.

RELIABILITY SIMULATION MODEL
B.H. Hershkowitz, et al., In: National Symposium on Reliability and Quality Control, 10th, Washington, D.C., Jan. 7-9, 1964, p. 186/200, 6 refs., A64-15948.

A DIGITAL SIMULATION OF RADIATION PATTERNS OF UHF ANTENNA ARRAYS
D.C. Luke, Air Force Inst. of Tech., Wright Patterson AFB, Ohio, Aug. 1963, 114 p., AD 420 011.

. . . application of digital computer techniques. The data required for a simulation are: The free-space radiation pattern of the antenna; the height of the antenna, and the conductivity and permittivity of the surface. Simulations of several antenna arrays are presented. The computation is made using a digital computer and the patterns are plotted using a microfilm recorder. . . .

NET-1 NETWORK ANALYSIS PROGRAM
A.F. Malmberg, et al., Los Alamos Scientific Lab., N. Mex., April 30, 1963, 150 p., 3 refs., N63-16522.

. . . for the MANNIAC II computer which simulates and describes through printed summaries and graphs the d.c. steady-state behavior and the transient behavior of a large class of electrical circuits which may contain passive and solid-state components. This report describes how the program is used. . . .

THE SPEED CONCEPT
H. Scharfman, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 399/401.

SPEED is an acronym for Signal Processing in Evacuated Electron Devices. . . is also a concept which implies that requirements for heretofore unavailable microwave components may be filled by applying techniques usually reserved solely for the development of electric beam microwave oscillators and/or amplifiers. . . . is a useful tool which should be used along with others available for the specification and solution of complex microwave component problems. . . .

SYSTEM RELIABILITY AND DOWN-TIME ANALYSIS
M.D. Schmid, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 747/752.

. . . describes a computer simulation program developed to aid in estimating the over-all system reliability and down time of the 600-foot radio telescope that was being designed for the U.S. Navy. . . . to provide for periodically updating and refining the estimates as improved input data became available. . . .

MINIMUM-ERROR DEMODULATION OF BINARY PCM SIGNALS
E.F. Smith, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 400/409.

. . . For additive, bandlimited white Gaussian noise, a method is developed for simulating with a digital computer the minimum-error demodulation. . . .

ANALOG COMPUTER SIMULATION OF A CURVED HYSTERESIS LOOP (Correspondence)
G.W. Swift, IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 324.

In a study of power transformers we have had occasion to simulate the hysteresis characteristic shown in Fig. 1, on an analog computer. Our method may be of interest to others faced with a similar problem.

REMOVING ARCS FROM A NETWORK
R. Wollmer, California U., Berkeley, Operations Research Center, ORC-64-5 (RR), 13 March 1964, 18 p., refs., N64-19774.

. . . Given a maximum flow network from which n arcs are to be removed, which n arcs, if removed, would reduce the flow to the greatest degree, and what would be this resulting maximum flow? An algorithm for solving such a problem is presented.

TRANSFER FUNCTIONS IN MATHEMATICAL SIMULATION FOR RELIABILITY PREDICTION
Sylvania Electric Products, Inc., Waltham, Mass., Rept. no. F 491-2, RADC TDR 63-87, Final report, 30 Jan. 1963, 175 p., incl. illus. tables, 27 refs., AD 402 154.

MATHEMATICAL SIMULATION AND ELECTRIC CIRCUITS (Proceedings of Seminar on Mathematical Simulation Methods and Electric Circuit Theories)
Joint Publications Research Service, Washington, D.C., JPRS-24041, OTS-64-21989, 6 April 1964, 360 p. refs., Transl. into English of the book "Mathematicheskoye Modeliroveniye i Elektrischeskiye Tsery (Trudy Seminara po Metodam Matematicheskogo Modelirovaniya i Teorii Elektri-cheskikh Tserey)" Kiev. no. 1, 1963, p. 1/247, N64-18093.

Related Publications:

THE DIGITAL COMPUTER AS A TOOL FOR NETWORK ANALYSIS
C.V. Anderson, et al., Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 644/651.

COMPUTER PROGRAM FOR PREPARING WIRING DIAGRAMS
D. B. Kirby, et al., Commun. and Electronics, vol. 80, no. 57, Nov. 1961, p. 509/513.

DEVELOPMENT OF OPTIMUM RHOMBIC ANTENNA DESIGN PARAMETERS
J.F. Bates, IEEE Internat. Conv. Rec., Pt. 1, vol. 11, March 1963, p. 26/29.

. . . A computer method for determining the antenna design parameters which maximize system response under the propagation conditions encountered on the specific propagation path is described. . . . is applied to design of rhombic antenna systems . . .

PATTERN RECOGNITION WITH SELF-ORGANIZING MACHINES
A. C. Foreman, Air Force Inst. of Tech., Wright Patterson AFB, Ohio, Aug. 1963, 90 p., AD 419 094.

. . . Computer simulations of a typical machine from each of three classes indicate that the noisy pattern recognition capabilities are poor for statistical-switching machines, good for threshold-logic machines, best for correlation type machines. . . .

Section 3A.64
Simulation of Communications Links

3A.642: Simulation of Channel Characteristics

Included: Simulation of HF communications effects; Fading simulator; Doppler spectrum simulator; Simulating noise characteristics; Simulated transmission impairments; Ionospheric propagation simulation.

Not Included: Characteristics of communications channels (1).

Cross References: Simulation of communications channels operation (3A.643); Simulation of communications networks (3A.650).

Principal Publications:

DESIGN CONSIDERATIONS FOR DOPPLER SPECTRUM SIMULATORS
S. Sherr, et al., Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 846/861.

. . . detailed description of requirements and demands of the simulator . . . unusual characteristics of the types of signals to be simulated . . . Representative specifications for each function as well as analytical techniques and experimental results illustrate the design considerations. . . .

STATISTICAL TREATMENT OF RADIO SIGNALS BY COMPUTERS
A.V. Prosin, et al., Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 5, 1961, p. 93/101.

An account is given of a method of handling signal data automatically in a digital computer. A description is given of an automatic device for recording the data on punch tape in a convenient form for direct introduction to the computer. The computer programme is also described. . . . tropospheric and ionospheric propagation of ultra-short waves has come under investigation . . .

DATA SYSTEM TESTS USING SIMULATED TRANSMISSION IMPAIRMENTS
F.T. Andrews, Jr., Commun. and Electronics, vol. 80, no. 58, Jan. 1962, p. 590/596.

. . . This test equipment, together with conventional random-data signal generators and error comparators, makes possible the evaluation of data systems with a wide range of transmission characteristics. . . .

PROGRAMMING STUDY FOR HIGH FREQUENCY EXOSPHERIC DUCTING
R. Beadle, et al., Electronic Associates, Inc., Princeton, N.J., Research and Computation, Div., Technical Rept. no. 1, Nov. 2, 1962, 54 p., 2 refs., N63-19517.

. . . detailed descriptions of special purpose circuits required to simulate the plasma channel are included.

COMPUTER SIMULATION ROUTINE FOR RADIO FREQUENCY BACKSCATTER: ANALYSIS FOR COMPUTER GENERATION OF NOISE
G.W. Evans, II, et al., Stanford Research Inst., Menlo Park, Calif., May 1962, 20 p., 4 refs., AD 277 582, N63-16833.

. . . simulation of the amplitude of noise signals which are bounded and are either time dependent or time independent. . . .

SIMULATION OF A FADING MEDIUM
R. Krulee, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 233/240.

. . . a model that is consistent with observed experimental data is developed for a fading circuit. . . .

MODEL STUDIES OF THE INFLUENCE OF IONOSPHERE PERTURBATIONS ON VLF PROPAGATION
S.W. Maley, et al., Colorado Univ., Boulder, Technical summary rept., 1 Jan. 1962-1 Jan. 1963, 1 Jan. 1963, 1 v., AD 420 379.

. . . the use of models to study propagation in the earth ionsophere-waveguide for cases in which the effective height of the ionosphere changes along the path of propagation. The models in this investigation will be used to directly gain information as to the effect of perturbations in the ionosphere upon propagation . . .

DISCRETE SMOOTHING FILTERS FOR CORRELATED NOISE
J.D. Musa, Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2121/2151.

. . . A simple method for generating discrete, wide-sense Markov noise for simulation is noted. . . .

HF COMMUNICATION EFFECTS SIMULATION: INSTRUMENTATION AND OPERATION OF THE FIELD EXPERIMENT
R.A. Shepherd, Stanford Research Inst., Menlo Park, Calif., Interim rept. 3, Dec. 1963, 103 p., AD 434 554.

. . . examination of six propagation paths, some of which pass through the auroral zone and some of which are south of the zone. . . . examined with oblique-incidence ionosphere sounders which collect propagation data between 4 and 64 Mc. . . . primary equipment used in the experiment . . . is described . . .

Related Publications:

FORWARD ACTING AUTOMATIC GAIN CONTROL
A. L. Hopper, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 358/370.

. . . Listening tests in the laboratory using recorded speech and simulated fading confirm the ability of FAAGC to suppress rapid fading. . . .

LINEAR SIGNAL PROCESSING THEORY AND MEASUREMENTS
A.H. Nuttall, Litton Systems Inc., Waltham, Mass., 30 April 1963, 79 p., AD 404 712.

A time-varying random linear system model is hypothesized for the communication medium. The fundamental parameters and analysis techniques for the linear system are described, and applied in a multiple alternative communication mode with Rayleigh fading. A comparison of several receiver types is then effected.

3A.643: Simulation of Communications Channel Operation

Included: Communications transmission engineering by computer simulation; Simulation of communications feedback channel; Simulation of data transmission code; Simulation in two-way controlled carrier transmission; Simulation of space communications links; Voice frequency telephone circuit design by simulation; COMSIMP.

Not Included: Controlled communications links with feedback (2); Error control coding methods (2).

Cross References: Simulation of channel characteristics (3A.642); Simulation of communications networks (3A.650).

Principal Publications:

AN ANALOG COMPUTER STUDY OF THE TRANSIENT BEHAVIOR AND STABILITY CHARACTERISTICS OF SERIAL-TYPE DIGITAL DATA SYSTEMS
O.I. Elgerd, Commun. and Electronics, July 1958, p. 358/366.

COMPUTER SIMULATION OF THE USE OF GROUP CODES WITH RETRANSMISSION ON A GILBERT BURST CHANNEL
W.R. Cowell, et al., Commun. and Electronics, vol. 80, no. 58, Jan. 1962, p. 577/585.

A study of error control by coding was made by Monte-Carlo simulation of a burst-noise channel on an IBM (International Business Machines) 7090. Using short group codes, comparisons were made between correction and detection with retransmission. Also, the effect of interleaving the code words was studied. Error detection with retransmission showed a consistently better performance than error correction and the time division resulting from interleaving was effective in combating burst type error patterns. . . .

CHARACTERISTICS OF THE SERVICE PROVIDED BY COMMUNICATION SATELLITES IN UNCONTROLLED ORBITS
J.D. Rinehart, et al., Bell Syst. Tech. J., vol. 41, no. 5, Sept. 1962, p. 1621/1670.

. . . This system has certain nonrandom characteristics, and the effect of these characteristics on the service to various parts of the world is examined by computer simulation.

TRANSMISSION ENGINEERING BY COMPUTER SIMULATION (Correspondence)
A.H. Ross, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 457/459.

Relatively simple mathematical methods are available for computing the maximum bit rates that can be transmitted over a few idealized types of digital circuits. Actual circuits in general can only be approximated by these models. For a more exact mathematical determination of the channel digital capacity, it is necessary to carry out a point by point computation. . . .

A DISCUSSION OF THE QUALITY FACTORS IN AN EARTH-SATELLITE-EARTH COMMUNICATION SYSTEM
N.W. Feldman, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 342/345.

. . . A description of a laboratory built simulated satellite communications system is given. . . .

SEQUENTIAL TRANSMISSION USING NOISELESS FEEDBACK
M. Horstein, IEEE Trans. Inform. Th., vol. IT-9, no. 3, July 1963, p. 136/143.

. . . simulating the system on an IBM 709 computer . . .

COMMUNICATION SATELLITE PROJECT ADVENT
D.F. Huebner, Space Sciences Lab., General Electric Co., Philadelphia, Pa., Final Technical rept., vol. 17, sec. 10, Ground Station Checkout, 15 March 1963, 12 p., AD 405 363.

A series of integrated over-all Tracking, Telemetry and Command (TT&C) system tests were conducted as a part of the ADVENT Program. Each participating TT&C Ground Station was checkedout and exercised in a System Acceptance Test. . . . it is necessary to utilize a TT&C simulation of the satellite.

QUASI-RANDOM CODE GENERATOR AND ERROR DETECTOR
P. McNelis, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 158/160.

. . . The quasi-random code generator and error detector . . . was designed as a simulator and a test device for operation in conjunction with the r-f link of the digital data transmission system. . . . provides a serial pulse pattern simulating a PCM information source. . . .

SIMULATION EXPERIMENTS IN TWO-WAY CONTROLLED CARRIER TRANSMISSION
R.J. Massa, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL-63-159, May 1963, 49 p., 12 refs., N63-19806, AD 412 459.

. . . power reductions due to controlled carrier transmission, and the results of an analog computer simulation demonstrating various aspects of controlled carrier operation are discussed. In addition, communication performance improvements in tropospheric scatter systems that may be obtained through the use of controlled carrier are cited, and related to corresponding improvements obtained with diversity and coding.

SIMULATION EXPERIMENTS IN TWO-WAY CONTROLLED CARRIER TRANSMISSION
R.J. Massa, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 159, Rev. Oct. 1963, 45 p., refs., AD 423 708, N64-12052.

AN AIRBORNE COMMUNICATION SIMULATION (COMSIMP)
I. Shear, Mitre Corp., Bedford, Mass., Rept. no. TM3844, ESD TDR 63 493, Feb. 1964, 122 p., AD 431 200.

. . . simulation of communication capability between two aircraft or between one aircraft and a ground station. . . . considers aircraft geometry, antenna radiation patterns, and transmitter power. . . . written for the IBM 7090 Digital Computer using the FORTRAN Symbolic language. . . .

VOICE-FREQUENCY TELEPHONE CIRCUIT DESIGN BY SIMULATION
T.J. Talley, et al., Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 564/568.

. . . A practical design for a transmission-circuit simulator to determine impedance, return loss, and frequency-attenuation characteristic is discussed. . . .

DELAY IN DATA TRANSMISSION THROUGH GENERAL NETWORKS
Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 65G7, ESD TDR63 597, 18 Dec. 1963, 54 p., AD 427 258.

. . . The link behavior assumed for this program is that obtained from measurements of two HF RTTY links . . . Simulation results . . .

Section 3A.65

3A.650: Simulation of Communications Networks and Traffic

Included: Traffic simulators for communications networks; Simulation of manned space flight ground communications networks; Analysis of delay in communications networks; Simulation of automatic routing methods.

Not Included: Network theory for communication networks; Topology; Adaptive communications methods (2).

Cross References: Communications oriented computer networks (3A.310).

Principal Publications:

ON OPTIMAL OPERATION OF COMMUNICATION NETS
I. Cederbaum, J. Franklin Inst., vol. 274, no. 2, Aug. 1962, p. 130/141.

Presents an approach to analysis of communication nets based closely on the theory of single-element-kind but not necessarily linear networks. The potential ability of networks to minimize some form of losses is applied to define an optimal operation of communication nets. . . . capable of distributing the flow throughout the network by taking into account both the network topology and the capacities of individual edges. . . . shows a systematic way leading to the solution which may be programmed on a digital computer.

DIGITAL COMPUTER SIMULATION OF COMMUNICATION NETWORKS
R. L. Dujack, et al., IRE Trans. Commun. Syst., vol. CS-10, no. 1, March 1962, p. 118/125.

In planning large scale communications networks, the systems engineer must define the best mix of system trunking assignments, switching logic, and system operating policies. . . . Digital computer simulations are a practical implementation of the modeling approach. If the input-output routines of the computer program are skillfully planned, the computer model can be used to evaluate a broad spectrum of system configurations and operating doctrines under arbitrarily selected changes in the system environment.

EVALUATION OF TACTICAL COMMUNICATIONS EFFECTIVENESS BY COMPUTER SIMULATION
J. J. Lamb, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 162/167.

LINK EVALUATION AND TAPE MERGING COMPUTER PROGRAMS
B. M. Sifford, Stanford Research Inst., Menlo Park, Calif., Final rept., Rept. no. TR7, Dec. 1962, 60 p., AD 434 833.

. . . computer program designed to predict the performance of communication networks using HF, ionospheric scatter, and tropospheric scatter propagation modes. The present report outlines the models and procedures used to write a computer routine to convert signal-to-noise predictions into a teletype character error rate for a channel and to estimate the useable number of teletype channels the circuit can support. The conversion considers such circuit parameters as teletype speed, teletype code, diversity reception, modulation and detection techniques.

SOME TRAFFIC CHARACTERISTICS OF COMMUNICATIONS NETWORKS WITH AUTOMATIC ALTERNATE ROUTING
J. H. Weber, Commun. and Electronics, vol. 81, no. 62, Sept. 1962, p. 247/256.

. . . A program was written for the International Business Machines Corporation 7090 computer which enables various alternate routing philosophies to be simulated and compared. . . .

OUTPUTS FROM THE NETWORK ANALYSIS COMPUTER PROGRAMS: A SUMMARY REPORT
E. M. Young, et al., Stanford Research Inst., Menlo Park, Calif., Final technical rept. no. 3, Dec. 1962, 196 p., AD 434 834.

Several computer programs have been produced that determine various properties of communication systems. These properties include both the performance of individual transmission links and the performance of an entire network. . . . A fairly large sample network is described that demonstrates each of the programs. . . .

COMPUTER DESIGN AND CONTROL OF PROBABILISTIC COMMUNICATION NETWORKS
R. C. Amara, IEEE Trans. Commun. Syst., vol. CS-11, no. 1, March 1963, p. 30/35.

A probabilistic communication network is one in which the modes and links are subject to random failure (or destruction). For a class of such probabilistic networks--in which user traffic demands are converted and stated in terms of required number of circuits or trunks between each node pair--an optimum method of design and utilization (or control) is described. . . .

DIGITAL SIMULATION TECHNIQUES APPLIED TO A COMMUNICATIONS SYSTEM
R. Archambault, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM632 000 01, 5 Aug. 1963, 32 p., AD 417 830.

TRAFFIC SIMULATION AND ITS APPLICATION IN TELEPHONY
G. Dietrich, et al., Elect. Commun., vol. 38, no. 4, 1963, p. 524/533.

. . . this paper primarily describes the method of generating artificial telephone traffic and presents some examples. . . .

STUDY OF AUTOMATIC ROUTING IN A SWITCHED SYSTEM UTILIZING SATURATION SIGNALING
Y. S. Fu, et al., North Electric Co., Galion, Ohio, Final rept., 1 July 1962-28 Feb. 1963, 28 Feb. 1963, 74 p., AD 421 688.

. . . results of a computer simulation of network configurations, methods of analyzing results of these simulations, proposed mechanization of the system . . .

ANALYSIS OF DELAY IN MATHEMATICAL SWITCHING MODELS FOR DATA SYSTEMS
D. G. Haenschke, Bell Syst. Tech. J., vol. 42, no. 3, May 1963, p. 709/736.

Traffic delay, caused by temporary all-lines-busy conditions, is analyzed for three mathematical switching models. They are classified as "address camp-on," "retrial," and "message storage" models. . . . Each model assumes that a message is switched only through one switching center which must establish connections via line groups to one or more addressed receiving stations . . .

A SIMULATION SYSTEM FOR THE MANNED SPACE-FLIGHT GROUND-SUPPORT NETWORK
L. L. Ruetz, et al., American Inst. of Aeronautics and Astronautics, New York, N. Y., In NASA, Flight Test Center AIAA/AFFTC/NASA FRC Testing of Manned Flight Systems, Dec. 1963, p. 109/113, N64-12882.

. . . will provide means of conducting training of ground control personnel for the network, and in connection with a spacecraft flight crew trainer, will permit realistic training of ground and spacecraft crews simultaneously.

SIMULATION OF DEFENSE COMMUNICATIONS SYSTEM
ITT Communication Systems, Inc., Paramus, N. J., Final summary rept., Rept. no. ICS64TR369, 13 Feb. 1964, 1 v., AD 429 327.

. . . comprehensive review . . . of the development of a computer simulator for the Defense Communications System (DCS) . . . provides . . . (DCA) with a management tool to assist in the efficient planning, operation and engineering of the DCS. The computer programs were written for use on the Philco S 2000 . . . and are currently being operated to provide solutions to real communication system problems.

COMPUTER SIMULATION MODEL OF LARGE SCALE DATA COMMUNICATIONS SYSTEMS
H. R. Seltzer, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1446/1458.

Demonstration is madeof how a digital communications system is simulated by a computerized model. . . . how the computer simulation becomes a helpful decision-making technique to guide the designer and engineering manager in designing to, and proving out the design to, systems specifications . . .

Related Publications:

A NON-REAL-TIME SIMULATION OF SAGE TRACKING AND BOMARC GUIDANCE
D. W. Ladd, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 36/41.

THE IMPORTANCE OF EXACT SOLUTIONS FOR THE DETERMINATION OF THE PROBABILITY OF A CALL LOSS IN THE CASE OF INCOMPLETE NETWORKS OF LINES (In German)
G. Bretschneider, Entwicklungsber, Siemens und Halske, vol. 24, no. 4, Dec. 1961, p. 407/412.

. . . traffic simulation . . .

ROUTING PROCEDURES IN COMMUNICATIONS NETWORKS--PART I: RANDOM PROCEDURES
R. T. Prosser, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 322/329.

. . . It is shown that random routing procedures are highly inefficient but extremely stable. A comparison of these theoretical results with the results of an extended computer simulation effort lends support to their reliability, discrepancies being accounted for by the simplifying nature of the statistical assumptions. . . .

ROUTING PROCEDURES IN COMMUNICATIONS NETWORKS--PART II: DIRECTORY PROCEDURES
R. T. Prosser, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 329/335.

OPTIMUM ROUTES IN COMMUNICATION SYSTEMS WITH CHANNEL CAPACITIES AND CHANNEL RELIABILITIES
I. T. Frisch, IEEE Trans. Commun. Syst., vol. CS-11, no. 2, June 1963, p. 241/245.

. . . algorithms are developed for finding routes between a given pair of stations, with maximum capacity and with reliability not less than some prescribed minimum value. . . .

TOPOLOGY ENGINEERING OF COMMUNICATION SYSTEMS
K. Ikrath, et al., IEEE Trans. Commun. Syst., vol. CS-11, no. 1, March 1963, p. 3/30.

. . . Connected linear graphs are introduced as symbolic models of communication systems. Their nodes of rank one, two, and larger symbolize terminal stations, repeater stations and exchanges of different sizes, respectively. Their branches symbolize circuits, lines or trunks. . . . an algorithm has been developed for the tabulation of matched sets of symbolic system elements (i.e., nodes), and tables of matched sets of nodes have been prepared both manually and with an automatic computer. The use of these tables is explained by practical examples dealing with synthesis problems of communication systems . . .

THE ERDAA MOBILE DIGITAL DATA TRANSMISSION LABORATORY
J. J. Lamb, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 193/204.

. . . Communication links incorporating standard Army equipment . . . must be adequately tested to determine quantitatively their transmission capability for digital data at the FIELDATA rates required for Army ADPS applications in a field environment. . . . Evolution of Test Techniques . . .

FINDING THE MOST RELIABLE ROUTES IN COMMUNICATION SYSTEMS
S. C. Parikh, et al., IEEE Trans. Commun. Syst., vol. CS-11, no. 4, Dec. 1963, p. 402/406.

. . . the problem . . . can be reduced to the problem of finding the shortest path between two nodes in a weighted linear graph. The known methods for finding the shortest path in a linear graph are extended to apply to any communication system, and simplified algorithms and computer subroutines are presented. . . .

Section 3A.66
Simulation of Space Flight Operation

3A.660: Space Flight Simulators in General

Included: Simulating manned space flight; Flight simulator for MIRAGE III: Complete flight trainers (with simulated communications and navigation); Lunar landing simulator.

Not Included: Training of astronauts.

Cross References: Simulation of active space flight control (3A.664); Simulation of ground communications networks for manned space flight (3A.650); Display systems (3A.380); Mission simulation (3A.661).

Principal Publications:

SYSTEM ORGANIZATION OF A MULTIPLE-COCKPIT DIGITAL OPERATIONAL FLIGHT TRAINER
J. H. Gray, Jr., et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 326/330.

. . . a digital computer whose purpose is to activate simultaneously more than one cockpit of an operational flight trainer. The simulated aircraft are assumed to be all of the same type, but each is simulated independently.

MARS FLIGHT II SPACE CABIN SIMULATOR
R. A. Ibison, Medical and Biological Problems of Space Flight, Proceedings of a Conference held in Nassau, the Bahamas, November 1961, Edited by Geoffrey H. Bourne, New York and London, Academic Press, 1963, p. 63/84, 31 refs., A63-19995.

Description of the Marsflight II, a large multi-man space-cabin simulator. It comprises a space cabin 24 ft. long and a ground-station complex of four console groups, including the main control, the ground radio and facsimile center, the biomedical center, and the maintenance and special operations station.

DESIGN STUDY FOR VFS-2, VOLUME 1
J. E. Conant, Melpar, Inc., Falls Church, Va., Final Technical Report, Sept. 1962, 212 p., N63-15804.

. . . visual flight simulation and several recommendations . . . most important of which . . . the multichannel television concept. . . .

FLIGHT SIMULATOR FOR MIRAGE III
S. M. Poole, Elect. Commun., vol. 37, no. 3, 1962, p. 196/201.

. . . simulator uses various electric and electronic systems to achieve faithful synthesis of all aspects of aircraft performance. . . .

A REVIEW OF IN-FLIGHT SIMULATION PERTINENT TO PILOTED SPACE VEHICLES
N. A. Armstrong, et al., Advisory Group for Aeronautical Research and Development, Paris, France, AGARD Rept. no. 403, July 1963, 19 p., AD 410 499.

. . . shows how the environment of actual flight may be used to simulate many phases of manned space exploration. . . survey . . .

THE ROLE OF SIMULATION IN THE DEVELOPMENT OF GEMINI GUIDANCE AND CONTROL
J. T. Clausen, Jr., In AIAA 2nd Manned Space Flight Meeting, 1963, p. 126/133, N63-23219.

. . . A simulated crew station with all the pertinent displays and controls has been constructed adjacent to the analog computer laboratory to permit real-time evaluation of guidance and control systems with man in the loop . . . Currently, the system is under modification to provide high fidelity projection of targets and backgrounds by means of a TV projection system.

FLIGHT-SIMULATOR REQUIREMENTS FOR HIGH-PERFORMANCE AIRCRAFT BASED ON X-15 EXPERIENCE
E. C. Holleman, et al., American Society of Mechanical Engineers, Aviation and Space, Hydraulic, and Gas Turbine Conference and Products Show, Los Angeles, Calif., 3-7 March 1963, Paper 63-AHGT-81, 12 p., A63-17579.

Simulator techniques which may be used in the supersonic-transport program, such as a variable-stability airborne simulator, are suggested.

DYNAMIC TASK SCHEDULING IN FLIGHT SIMULATORS
J. M. Kurtzberg, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 767/780.

LUNAR LANDING BY COMMAND GUIDANCE IN THE PRESENCE OF TRANSMISSIONS TIME-DELAY
H. F. Meissinger, American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Cambridge, Mass., Aug. 12-14, 1963, Paper 63-346, 17 p., A63-20669.

. . . methods considered involve complex, time-variant, and nonlinear feedback systems and the largely unknown dynamic response of the human operator. . . . simulator used is described in an appendix.

ORBITAL FLIGHT SIMULATION
R. Reid, et al., Presented at the AIAA Guidance and Control Conf., Cambridge, Mass., Aug. 12-14, 1963, AIAA Paper 63-311, N63-19472.

. . . orbital flight simulation equipment or procedures which will provide realistic and useful exercise without degrading the reliability of flight-control systems or imposing excessive weight and volume penalities. . . .

SIMULATING MANNED SPACE FLIGHT
O. Romaine, Space/Aeronautics, vol. 40, Dec. 1963, p. 68/72, A64-12903.

Discussion of space-flight simulation programs and facilities from the research standpoint. The four basic parts of a space-flight simulator are the vehicle command station, with its controls, instruments, and displays; the out-of-window displays; the motion-generating equipment for the vehicle or displays; and the computation setup. . . .

A VISUAL PRESENTATION SIMULATOR USED FOR INVESTIGATIONS OF VARIOUS PHASES OF LUNAR FLIGHT
J. E. Willer, In AIAA 2nd Manned Space Flight Meeting, 1963, p. 92/98, refs., N63-23214.

. . . consists of a full-scale fixed-base cockpit mockup with operating instruments, a closed-circuit television system, a terrain model, a servo powered six-degree-of-freedom TV camera transport, and an analog computer . . .

TESTING OF MANNED FLIGHT SYSTEMS CONFERENCE, EDWARDS AFB, CALIF., DECEMBER 4-6, 1963, PROCEEDINGS
New York, American Institute of Aeronautics and Astronautics, 1963, 123 p., A64-11331.

Collection of papers dealing with recent developments in methods for testing and simulating aircraft and spacecraft flight conditions. Among the topics discussed are in-flight testing of inertial navigation systems, flutter onset at subcritical speeds, satellite thermodynamic analytical techniques; and simulation of the X-20 hypersonic research vehicle, and of a manned spaceflight ground support network.

AIAA SIMULATION FOR AEROSPACE FLIGHT CONFERENCE
New York, American Institute of Aeronautics and Astronautics, 1963, 370 p., A63-20553.

. . . descriptions of specific flight simulators . . . discussion of simulator studies . . . computer applications to structural analysis and aeroelasticity problems. Simulations of spacecraft deployment dynamics, orbital rendezvous, and terminal guidance. . . .

Related Publications:

LE ROLE DES CALCULATRICES ELECTRONIQUES DANS LA CREATION DES SYSTEMES DE LANCEURS SPATIAUX (The Role of Electronic Computers in the Implementation of Space Launching Systems) (In French)
Fusees, no. 22, 1963, p. 7/14, A64-11020.

. . . Described is an electronic simulator which calculates in actual time and handles simultaneously piloting and guidance problems with the accuracy desired. Examples are given of a mixed-type simulator operating in actual time.

3A.661: Mission Simulation

Included: Simulated flight programs; Omnibus calculator for simulation of trajectories; Simulation error analysis for space missions; Terminal phase intercept (TEPI) model; Computer program for orbit determination analysis; SATRAK simulator; Integrated mission simulator; Simulation of trajectories for manned lunar landing.

Not Included: Theory of orbital calculations.

Cross References: Computer programs in general (3A.150); Space flight simulators in general (3A.660); Terminal guidance simulator (3A.663).

Principal Publications:

IBM 704 PROGRAM FOR A TERMINAL PHASE INTERCEPT (TEPI) MODEL
R. Herrmann, Technical Military Planning Operation, General Electric Company, Santa Barbara, Calif., RM 62 TMP 80, Dec. 1962, 89 p., AD 406 837.

SIMULATION ERROR ANALYSIS SYSTEM, PROGRAMMING DOCUMENT
Aeronutronic, Newport Beach, Calif., ESD TDR62 340, 30 Nov. 1962, 1 v., AD 403 981.

. . . theory, program philosophy, and operating instructions for the Simulation Error Analysis System (COSINE 5B) . . . provides an automatic means with which the observations of a specified orbit obtained from a sensor network may be simulated and analysed . . . capability of predicting future position and velocity error caused by the uncertainty in the orbit elements.

ROCKET - RAND'S OMNIBUS CALCULATOR OF THE KINEMATICS OF EARTH TRAJECTORIES
Barry W. Boehm, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1964, 254 p.

. . . mathematically simulates the flight of aerospace vehicle and has the ability to handle flight programs as elaborate as that of a multistage powered vehicle about a rotating oblate planet with a rotating atmosphere. . . . The program itself is written in FORTRAN II, and it allows the user to specify a vehicle's characteristics and its flight plan, both of which may vary through a wide range of choices.

THE SATRAK SIMULATOR
C.H. Bredall, Aerospace Corp., Los Angeles, Calif., TDR 169 3305 TN3, 30 March 1963, 22 p., AD 402 684.

The SATRAK Simulator (SAtellite TRajectory and Attitude Kinematic Simulator) is an instrument which can quickly measure simulated satellite aspect as a function of sensor location, satellite trajectory, satellite attitude, and time. . . .

TERMINAL GUIDANCE SIMULATOR STUDY PROGRAM IMAGE EVALUATION. VOLUME II. RESULTS OF EXPERIMENT
B. L. Cole, et al., Northrop Corp., Hawthorne, Calif., Rept. no. NOR64 10, Jan. 1964, 64 p. AD 427 866.

. . . two volumes. Volume I covers . . . the theory of image formation, and an application is made to television imaging systems . . . Volume II . . . image evaluation experiment . . . to provide objective methods of assessing characteristics of optical systems as opposed to the usual subjective approach . . . considered were transfer characteristic, the sine wave response, and the signal-to-deviation ratio . . . As a result . . . methods are now available to assess the characteristics of imaging systems prior to design. A common language is provided to describe the performance of elements in an optical system . . .

SYNTHESIS OF CONTINUOUS ANALOG DATA FROM DISCRETE SAMPLE DATA VIA A PB250- TRICE LINK
J. C. McCoy, National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala., 2 Jan. 1964, 24 p., N64-18101.

A procedure is described for using discrete, widely dispersed measurements of wind velocity to generate continuous curves suitable for use as driving functions in a simulated flight of the Saturn Vehicle . . . The problem is solved by first, on the 7090, fitting the 26 values in each set of measurements with a fifth-order smoothing equation. The 7090 next breaks the smoothing curve into 125 segments of equal width, calculates the slopes of straight lines connecting the endpoints of these segments, and records the slopes on tape in PB250 format. With the PB250 acting as interpreter, the TRICE is then used to integrate the slopes with respect to time . . .

SIMULATION OF MANNED LUNAR LANDING
E. Markson, et al., In: Technology of Lunar Exploration. Progress in Astronautics and Aeronautics, vol. 10, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 561/588, A63-23438.

Description of a predictive type of guidance system for a man-in-the-loop lunar landing which uses a novel solution to three-dimensional particle motion for repeated predictions of trajectory end conditions. . . .

THE INTEGRATED MISSION SIMULATOR
E. E. Markson, et al., In: AIAA Simulation for Aerospace Flight Conference, Columbus, Ohio, Aug. 26-28, 1963, New York, American Institute of Aeronautics and Astronautics, 1963, p. 230/243, A63-20580.

. . . development of an analog program capable of continuously simulating an entire lunar mission in six-degrees-of-freedom with high resolution throughout. The program is traced through the equations of motion, the guidance and control equations, and the analog mechanization. . . . A previously reported guidance technique is shown to be applicable to all phases of the mission. It is concluded that the method leads to minimum computer loading for simulating a manned space mission without program discontinuities. . . .

SIMULATION MODELS FOR SPACE LOGISTICS ANALYSIS
R. P. Richardson, et al., Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 23-27, 1963, Paper 759D, 16 p., A63-25888.

. . . provide the information needed in selecting the flight transportation system, the mission profile, the scope of the space activities supported, funding requirements, and schedules. Monte Carlo techniques are used in implementing the simulation model. . . .

ORBIT DETERMINATION ERROR ANALYSIS
D. R. Speech, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR 269 4110 3, Aug. 1963, 31 p., AD 419 467.

. . . The conclusions are based on the results of a large number of digital simulations with the Aerospace TRACE program and the General Electric Pat-B program, plus limited experience in the reduction of "live" data from the SCF net.

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 17/24.

. . . A digital computer program which will simulate spacecraft missions is being developed for the IBM 7094 computer. . . .

Related Publications:

ORBIT DETERMINATION ERROR ANALYSIS
D. R. Speece, In AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., vol. 2, 1963, p. 197/228, N64-15260.

The problem of orbit determination by radar tracking data is broken into its constituent parts . . . The behavior of orbital errors is interpreted in terms of the influence of their sources and the nature of their propagation. . . .

3A. 662: Electronic Space Environment Simulation

Included: Space craft motion simulator (for antenna attitude tests); Space craft attitude simulators for control system tests; Signal environment simulators; Countermeasure simulators; Electromagnetic environment simulation.

Not Included: Electromagnetic compatibility; Simulators for physical space environment; Radiation simulators.

Cross References: Simulation of channel characteristics (3A. 642).

Principal Publications:

SIGNAL ENVIRONMENT SIMULATOR STUDY
J. R. Wolcott, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 279/281.

It was proposed to construct a simulator which could, in effect, replace a large variety of antennas employed in a receiving facility. . . . The signal output from the simulator must be as nearly like the signals from an actual antenna as possible. . . .

ELECTROMAGNETIC ENVIRONMENT SIMULATION FOR SYSTEM TRAINERS
F. P. Cullen, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 331/337.

. . . use must be made of simulator devices that can present with a high degree of realism the conditions that the operator would experience during an actual mission. . . .

THE DEVELOPMENT OF A DYNAMIC TARGET AND COUNTERMEASURES SIMULATOR
R. L. Norton, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 338/342.

FEASIBILITY STUDY AND DESIGN PROGRAM FOR A LABORATORY SIMULATION TESTING FACILITY, VOLUME I
Aerospace Communications and Controls Div., Radio Corp. of America, Burlington, Mass., Rept. for 1 May 1961 - 30 Nov. 1962, RADC TDR63, 28, vol. 1, March 1963, 1 v., AD 411 555.

. . . The objective was to perform a study and investigation of the feasibility of applying simulation techniques to the problem of evaluating the compatibility of electronic equipment in simulated environments derived from mathematically modeled electromagnetic environments . . . preliminary performance specifications representing the most feasible approach to RFI simulation . . .

DYNAMIC ANALYSIS OF OAO SPACECRAFT MOTION OF ANALOG-DIGITAL SIMULATION
G. Zetkov, et al., IRE Internat. Conv. Rec., Pt. 5, vol. 10, March 1962, p. 282/296.

. . . One of the major subsystems of the OAO spacecraft is the Stabilization and Control Subsystem. . . . involves control of spacecraft attitude about all three of its axes and is utilized when a particular class of experiments is being performed and also during the transition to the fine pointing mode, in which other experiments are performed. . . .

Selection of the combined analog-digital simulation technique for the dynamic analysis of course pointing control was based mainly on . . . (1) ease of mechanizing logic, (2) machine time, and (3) fidelity of simulation. . . .

FEASIBILITY STUDY AND DESIGN PROGRAM FOR A LABORATORY SIMULATION TESTING FACILITY
Aerospace Communications and Controls Div., Radio Corp. of America, Burlington, Mass., Final rept., RADC TDR 63 200, June 1963, 1 v., AD 409 300.

. . . applying simulation techniques to the problem of evaluating the compatibility of electronic equipments in simulated environments derived from mathematically modeled electromagnetic environments . . . Results . . . have proven the feasibility . . . for the simple noncoherent pulsed search radar case.

Related Publications:

AUTOMATED SOLUTION OF COMBINED INTERFERENCE MATRICES
I. E. Perlin, et al., Georgia Inst. of Tech., Engineering Experiment Station, Atlanta, Final rept., 15 Nov. 1961-15 Nov. 1962, 15 Nov. 1962, 178 p., AD 299 248.

A SPACECRAFT MOTION SIMULATOR: FEATURING UNLIMITED ANGULAR FREEDOM
F. E. Altoz, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 447/450.

. . . training astronauts for future space missions . . .

3A.663: Simulation of Navigational Operations

Included: Terminal guidance simulator; Target simulators for space tracking; Land mass radar simulation; Simulation of special radar systems; Radar target simulators; Tracking simulation methods; Post flight simulation.

Not Included: Detection theory (including radar detection) (2); Radar technology.

Cross References: Simulation of electronic circuits (3A.630).

Principal Publications:

CONTROLLABLE RADAR TARGET SIMULATOR
L. Michels, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 420/426.

The Controllable Radar Target Simulator (CRTS) was developed by the System Development Corporation for use in the Manual System Training Program of the Air Defense Command. . . .

AN EVALUATION OF TECHNIQUES IN LAND MASS RADAR SIMULATION
G.M. Dembo, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 568/574.

A PRECISION DOPPLER GENERATOR FOR RADAR TARGET SIMULATION
C. Faustini, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 515/520.

The calibration and checkout of the more advanced Instrumentation Radars requires an accurate Target Simulator. As an intermediate step this requires the generation of a sinusoidal waveform whose instantaneous frequency can be made to follow a prescribed curve with a high degree of accuracy. Digital and analog techniques are combined here in a conceptually new method to obtain this purpose. . . .

DIGITAL SIMULATION OF PULSE DOPPLER TRACK-WHILE-SCAN RADAR
W.A. Bishop, et al., IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 94/100.

. . . A realistic signal output from the filter bank is obtained by simulating one or more dynamic targets with independent scintillation and then adding simulated receiver noise. This output data is then translated into target tracks by the radar data processor. . . .

FEASIBILITY STUDY OF THE DEVELOPMENT OF A DIGITAL COMPUTER ROUTINE FOR THE SIMULATION OF RADIO FREQUENCY BACKSCATTER FROM SPACE VEHICLES AND OF MATHEMATICAL METHODS FOR ANALYZING DIGITALIZED BACKSCATTER DATA
R.C. McCarty, et al., Stanford Research Inst., Menlo Park, Calif., Technical rept. no. 1, Feb. 1962, 51 p., AD 416 573, AD 434 855.

. . . preliminary analytical investigations required to delineate computer routines for (1) the simulation of RF backscatter from space vehicles and (2) the analysis of digitalized backscatter data . . .

TARGET SIMULATOR FOR SPACE-TRACK SYSTEM COMPUTER TESTS
K.R. Brown, Jr., International Business Machines Corp., New York, Rept. no. TN24, 5 Sept. 1963, 14 p., AD 424 357.

ACQUISITION PROGRAM FOR TRACKING AND SURVEILLANCE OF EARTH SATELLITES
A.P. Callanan, et al., Aeronutronic, Newport Beach, Calif., Rept. no. U1854, ESD TDR 63 615, Oct. 1963, 72 p., AD 421 692.

. . . This computer program may be used to simulate sensor-satellite patterns or to generate calculations for real satellites and existing sensors.

AN LRR SIMULATION MODEL
R. L. Dugas, System Development Corp., Santa Monica, Calif., 15 May 1963, 24 p., AD 407 129.

A computer based mathematical model was developed for the purpose of studying the generation of SAGE long range radar data. In its present form the model simulates one radar and one target. Inputs are radar characteristics and target data. The outputs include sequences of quantized radar video as they would appear on the drum of the AN/FST-2. . . .

A SAGE LONG-RANGE-RADAR SIMULATION MODEL
R. L. Dugas, System Development Corp., Santa Monica, Calif., TM1042 101 00, 15 March 1963, 14 p., AD 404 721.

ERROR ANALYSIS OF A DOPPLER — INERTIAL NAVIGATION SYSTEM BY ANALOG SIMULATION
K.A. Fegley, et al., IEEE Trans. Commun. Electronics, no. 66, May 1963, p. 123/130.

1604 SIMULATION PROGRAM DESCRIPTIONS. MILESTONE XI, TRACKING DATA PAPER TAPE GENERATION ROUTINE (SRADTPE)
P. T. Kastama, System Development Corp., Santa Monica, California, TM L734 037 00, 15 March 1963, 23 p., AD 404 658.

. . . provides a simulation capability which will produce tracking data on paper tape for un-augmented tracking stations. These data are intended to represent the actual data generated by various antennas during vehicle pass-over for a given station, vehicle, and revolution number.

POST-FLIGHT SIMULATION
J.N. Myers, In: AIAA Simulation for Aerospace Flight Conference, Columbus, Ohio, Aug. 26-28, 1963, New York, American Institute of Aeronautics and Astronautics, 1963, p. 220/229, A63-20579.

Description of PFAN, a program for the 7090 computer, which fits a simulation to data from an Atlas flight. PFAN simulates the post-flight and makes the comparison with radar data automatically in a single run, and also uses steering commands from the flight.

1604 SIMULATION PROGRAM DESCRIPTIONS MILESTONE XI, TRACKING REPORT PROCESSOR FOR AUGMENTATION (STRK)
J.D. Solomon, System Development Corp., Santa Monica, Calif., TM L734 021 00, 13 March 1963, AD 404 693.

. . . used to output tracking reports previously generated and recorded on magnetic tape by the SIPSA (Simulated Input Preparation System for Augmentation) system. Data are processed for the VERLORT, TLM18, Angle Tracker, TEL-DATA, PRELORT, and Disk-on-Rod antennas.

SPECIAL PARAMETER TRACKING SIMULATION STUDY. VOLUME III. SUMARIZATION MATERIAL
Philco Corp., Palo Alto, Calif., Rept. no. WDL-TR1943, vol. 3, 31 Jan. 1963, 1 v., incl. illus., tables, AD 400 130.

. . . prepared as a design trade-off handbook for error propagation in orbit determination.

SPECIAL PARAMETER TRACKING SIMULATION STUDY LOW ALTITUDE SATELLITE, VOL. IV.
Philco Corp., Palo Alto, Calif., Technical documentary rept., Rept. no. WDL-TR1943, vol. 4, 22 April 1963, 1 v., incl. illus., tables, AD 402 218.

. . . presents results in satellite position and velocity accuracy as a function of tracking data, number of passes, station latitude separation, and other pertinent variables in graphical form. . . . to be used as a design tradeoff handbook for error propagation in orbit determination . . . obtained by using the Co-Variance (Fixed Bias) Simulator Program.

OPERATING INSTRUCTIONS FOR THE AUGMENTED TRACKING STATION SIMULATION PROGRAM SIMSTN (MILESTONE 7)
System Development Corp., Santa Monica, Calif., Technical memo no. TM-(L)-734/033/00, 20 Feb. 1963, 10 p., AD 299 104.

OPERATING INSTRUCTIONS FOR THE AUGMENTED TRACKING STATION SIMULATION PROGRAM (SIMSTN) - MILESTONE 7
System Development Corp., Santa Monica, Calif., TM L734 033 00A, 28 March 1963, 9 p., AD 404 659.

INVESTIGATION OF DIGITAL TECHNIQUES FOR RADAR LAND MASS SIMULATION
Pennsylvania Research Associates, Inc., Philadelphia, 23 Aug. 1963, 206 p., AD 424 625, N64-12076.

. . . discussion of two basic methods of representing natural terrain in digital form-function approximation and contour interpolation. It formulates a model for the encoding and preparation of map data and for equipment to reconstruct terrain profiles in real-time synchronism with the display of an airborne radar.

Related Publications:

FCT, A NEW SEQUENTIAL DETECTION METHOD FOR MULTIPLE-RESOLUTION-ELEMENT RADAR
G.M. Dillard, Navy Electronics Lab., San Diego, Calif., Research Report, 1 Jan. - 1 Sept. 1963, NEL-1201, 25 Oct. 1963, 32 p., refs., N64-17363.

Simulation of the FCT (forced continuation testing) mode in processing binomially quantized radar-receiver output voltage gave data that agreed well with exact, computed results . . .

3A.664: Simulation of Active Space Flight Control Systems

Included: Simulation, calibration system for landing and rendezvous operations; Terminal guidance simulation; Re-entry vehicle flight simulation; Rendezvous control simulation; Docking simulator; Orbital closure simulator.

Not Included: Space flight control equipment.

Cross References: Mission simulators (3A.661); Integrated space flight simulators (3A.660).

Principal Publications:

UTILIZATION OF UDOFTT (UNIVERSAL DIGITAL OPERATIONAL FLIGHT TRAINER TOOL) IN TRAINING RESEARCH
M. Fischer, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 462/491.

USE OF A COMBINED ANALOG-DIGITAL SYSTEM FOR RE-ENTRY VEHICLE FLIGHT SIMULATION
A. N. Wilson, Proc. Eastern Joint Comp. Conf., Dec. 1961, p. 105/114.

. . . a joint digital-analog computing facility with inter-communication capabilities . . . an example of the use of such to the analysis of a spacecraft atmospheric re-entry. The computing facility consists of an IBM-7090 general purpose digital computer, an Electronic Associates analog computer, and an Epsco analog-to-digital, digital-to-analog conversion system known as the Addaverter.

FLIGHT SIMULATION OF ORBITAL AND RE-ENTRY VEHICLES
L. E. Fogarty, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 555/563.

The three translational and three rotational equilibrium equations for an orbital vehicle subject to aerodynamic and jet reaction forces are derived using a modified flight-path axis system for the translational equations.

A SIMULATION — CALIBRATION SYSTEM FOR SPACE FLIGHT LANDING AND RENDEZVOUS CONTROL SYSTEMS
W. J. Hollandsworth, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 585/589.

. . . a new time delay generator system for use in radar target simulation. The system not only provides static delay, but also generates dynamic delay analogous to velocity and acceleration. Instrumentation employed includes well established digital counting techniques combined with a unique method of pulse phase synchronization. . . .

REQUIREMENTS FOR A SPACE VEHICLE CLOSURE AND DOCKING SIMULATOR
W. L. DeRocher, Jr., et al., American Institute of Aeronautics and Astronautics, guidance and Control Conference, Cambridge, Mass., Aug. 12-14, 1963, Paper 63-363, 10 p., A63-20674.

A MULTIMAN-MACHINE SYSTEM SIMULATION FACILITY AND RELATED RESEARCH ON INFORMATION-PROCESSING AND DECISION-MAKING TASKS
J. B. Feallock, et al., Ohio State U., Columbus, Laboratory of Aviation Psychology, Wright Patterson AFB, Ohio, Behavioral Sci. Lab., Final Report, April 1, 1960-Feb. 28, 1963, AMRL-TDR-63-48, June 1963, 150 p., 33 refs., N63-19739, AD 411 552.

. . . covers a series of studies on information-processing and decision-making behavior for individuals and for teams performing experimental tasks. . . . development of a general-purpose, multiman system simulation facility for laboratory research on team performance within the context of realistic task environments. . . . exploratory research with a small-scale simulator (IPAC), and of a large-scale simulator (Comcon) . . . studies of system performance on the IPAC simulator . . .

FLIGHT CONTROL MALFUNCTION MANAGEMENT FOR THE GEMINI LAUNCH VEHICLE
H. Hecht, Aerospace Corp., Los Angeles, Calif., TDR 169 3126 TN 4, 12 July 1963, 112 p., AD 411 856.

. . . examples of switchover simulations . . . over-all evaluation of the protection afforded by the malfunction management system as presently planned . . . discussion of an alternate implementation which may be considered in the future for similar vehicles.

RENDEZVOUS DISPLAY AND CONTROL SIMULATION
J. E. Holthaus, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 786/794.

Display and control techniques associated with the rendezvous of a spacecraft . . . were investigated. In order to acquire representative data and conditions, an analog computer providing for real time studies in six degrees of freedom, and a simulated spacecraft cockpit with displays and controls were mechanized. Target range and bearing information was programmed by the computer while the operator in the cockpit made the necessary changes in oribital velocity to accomplish near docking. . . .

A DIGITAL SIMULATION APPARATUS FOR HUMAN OPERATOR STUDIES, WITH PARTICULAR REFERENCE TO THE CONTROL OF VTOL AIRCRAFT
E. R. Petersen, In: National Research Council of Canada, Ottawa, Quarterly Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., 1 Jan. to 31 March 1963, p. 41/55, 8 refs., N63-18068.

To optimize the man-machine combination in complex control situations . . . conditions aboard a VTOL aircraft in hovering or near-hovering flight and to actuate the "moving platform" and visual displays. The required "real time" simulation equipment is described and simulation methods, using analog and digital computers, are compared as to their speed, accuracy, reliability, size and power, cost, expansion, and flexibility. . . .

RENDEZVOUS, DOCKING AND TRANSFER
N. Petersen, In: Aerospace Med. Div., Brooks AFB, Tex., School of Aerospace Med. Lectures in Aerospace Med., 4-8 Feb. 1963, p. 185/238, 7 refs., N63-20564.

. . . (6) rendezvous, docking and coupling simulation. . . .

LANGLEY RESEARCH CENTER SIMULATION FACILITIES FOR MANNED SPACE MISSIONS
W. H. Phillips, et al., American Society of Mechanical Engineers, Aviation, and Space, Hydraulic, and Gas Turbine Conference and Products Show, Los Angeles, Calif., March 3-7, 1963, Paper 63-AHGT-91, 10 p., 25 refs., A63-17763.

. . . for the study of piloting problems of space vehicles. . . .

SIMULATION TECHNIQUES FOR ASTRONAUT TRAINING
J. Prodan, In: Advances in the Astronautical Sciences, vol. 16, pt. 1, Space Rendezvous, Rescue, and Recovery, Edited by Norman V. Peterson, North Hollywood, Calif., Western Periodicals Co., 1963, p. 566/572, A63-24775.

A FULL-SCALE SIX-DEGREE-OF-FREEDOM, ORBITAL CLOSURE AND DOCKING SIMULATOR
G. H. Smith, et al., In: Advances in the Astronautical Sciences, vol. 16, pt. 1, Space Rendezvous, Rescue, and Recovery, Edited by Norman V. Petersen, North Hollywood, Calif., Western Periodicals Co., 1963, p. 545/565, A63-24774.

. . . advantages of a closure and docking simulator, as distinct from a rendezvous simulator. . . . It is shown that a combination simulator consisting of a computing machine and a servo-driven mechanical system is advisable. . . .

Related Publications:

DEVELOPMENT OF A VARIABLE CONTROL FEEL SIMULATOR
J. F. Watler, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 647/658.

Operational achievements and trends which influence the design of aircraft manual and automatic flight control systems are briefly reviewed. . . . importance of control feel as a design parameter is cited. . . . experimental methods . . . needs in this area of research are defined. Equipment developed to meet these needs is described . . .

3A.665: Simulation of Passive Flight Control Operations

Included: Flight safety simulators; ATC = air trafic control simulator; Simulation of landing systems.

Not Included: Air traffic technology; Space traffic control facilities.

Cross References: Simulation of active space flight control operations (3A.664).

Principal Publications:

SIMULATION FOR A DYNAMIC ANALYSIS OF AN AIRBORNE VISUAL LANDING AID SIGHT SYSTEM
R. C. McLane, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 289/294.

The analog computer study phase of an Air Force sponsored program for development of a visual landing aid sight system is described. . . .

LE CALCULATEUR NUMERIQUE: ELEMENT CENTRAL D'UN SIMULATOR DE CONTROLE DE LA CIRCULATION AERIENNE (The Numerical Computer: Central Element of an Air Traffic Control Simulator) (In French)
A. Herrent, International Symposium on Analog and Digital Techniques Applied to Aeronautics, Liege, Belgium, Sept. 9-12, 1963, Paper, 24 p., A64-16483.

Description of an air traffic control simulator, using the numerical computer as the heart of the system. . . . Study of the problem led to use of two computers, a memory block, and applicable tape recorders. The system is stated to have great flexibility, and because of the division of tasks between two computers, it has double the capacity of a universal computer, especially in preparation and evaluation of exercises.

AN AIR TRAFFIC CONTROL RADAR BEACON DECODER SIMULATOR SYSTEM
A. I. Perlin, IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 136/140.

. . . A device is described which produces the same observable effect as an operational Radar Beacon Decoder. Four categories of display are generated . . . The resulting display is a variant of the usual radar presentation, and serves to identify certain classes of targets and also Emergency conditions. The simulator operates in a manner similar to an actual Decoder. . . .

DYNAMIC SIMULATION STUDIES OF PICTORIAL NAVIGATION DISPLAYS AS AIDS TO AIR TRAFFIC CONTROL IN A LOW-DENSITY TERMINAL AREA AND IN AN EN ROUTE AREA
A. L. Sluka, Federal Aviation Agency, Systems Research and Development Service, Atlantic City, N. J., Final Report, Feb. 1963, 73 p., N63-17438.

. . . describes an ATC dynamic simulation study that was conducted to determine the operational value of cockpit pictorial displays, course line computers, and pictorial computers as aids to air traffic control in a low-density terminal area and in an en route area. . . .

FLUGSICHERUNGS-SIMULATORAN-LAGE FUR EUROCONTROL (Flight Safety Simulator For Eurocontrol) (In German)
Luftfahrttecknik Raumfahrttechnik, vol. 10, Feb. 1964, p. 56/59, A64-16048.

. . . a simulator which approximates the air traffic in a 2000-km-diameter region, including the effects of six primary-and six secondary-radar installations scattered arbitrarily throughout the region. The central unit of the simulator is a digital computer which develops the data transmission program for such tasks as the preparation of the simulation exercise, carrying out the simulation under real-time conditions, and the statistical evaluation of the results. Described in some detail are the TR 4 digital computer employed, the display unit, radar simulation, and the data transmission unit.

Section 3A.68
Other Related Simulation Activities

3A.680: Various Special Simulation Methods

Included: Threat warning simulation; Electronic simulator for industrial processes; Simulators for submarine operation; ASW simulation facilities.

Principal Publications:

SIMULATION TO OBTAIN A SYSTEMS MEASURE OF AN AIR DUEL ENVIRONMENT
A. A. B. Pritsker, et al., IRE Trans. Electronic Comp., vol. EC-8, no. 1, March 1959, p. 55/59.

A combined analog-digital simulation of an air battle between an attacking bomber aircraft and a ground controlled interceptor, including the intermediate human radar operator, has been designed for the purpose of evaluating the effects of airborne electronic countermeasures upon a ground-based radar operator. Both real and nonreal time simulation are used . . .

TACTICS AND "DIVING" SIMULATORS FOR TRAINING IN OPERATION OF HIGH SPEED SUBMARINES
A. P. Vigliotta, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 282/288.

COMPUTER CONTROLLED ASW TRAINING FACILITY
E. B. Boyle, Jr., et al., IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 73/85.

. . . Use of a general-purpose digital computer to control a complex submarine ASW training facility . . . the computer generates, under the control of program operators, the courses of submarines, ships, aircraft and weapons to create the training environment.

ELECTRONIC SIMULATOR FOR PROCESSES
W. H. Hassall, et al., ISA Journal, vol. 9, March 1962, p. 60/63.

Electronic process simulators are described and their applications are discussed. The device is employed to familiarize operators and mechanics with unusual procedures without introducing costly and/or dangerous disturbances to the actual continuous processes.

ANALOG SIMULATION OF A THREAT WARNING PROCESSOR
J. Beard, et al., Institute of Science and Tech., Univ. of Michigan, Ann Arbor, Rept. no. 4479 26T, ASD TDR63 850, Oct. 1963, 27 p., AD 423 194.

The feasibility of calculating two threat estimators for warning aerospace vehicles of attack was investigated by analog simulation. The first of these estimators is the ratio of range (between target and attacking vehicle) to its time derivative (range rate). The second estimator is related to the first, and represents a more complicated function of range. . . .

3A.682: Simulation of Mechanical Processes

Included: Simulation of dynamic pressure during re-entry; Simulation of structural stresses and damping; Simulation of ion propulsion activities.

Cross References: Active flight control simulators (3A.664).

Principal Publications:

OPERATIONAL ANALOG SIMULATION OF THE VIBRATION OF A BEAM AND A RECTANGULAR MULTICELLULAR STRUCTURE
A. B. Clymer, IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 381/391.

A feasibility study of the use of an operational analog computer for solution of structural problems was undertaken. . . . the method is highly competitive with digital computer and passive-element computer methods for solution of any structural problem.

DISTRIBUTED PARAMETER VIBRATION WITH STRUCTURAL DAMPING AND NOISE EXCITATION
R. V. Powell, IRE Trans. Electronics Comp., vol. EC-8, no. 2, June 1959, p. 197/200.

. . . electronic analog computer that will permit the determination of the vibration amplitude responses of a distributed system with structural damping to a random-noise excitation such as might be experienced by a missile structure accelerated by a jet propulsion system. Simulation of the structure by a method of normal modes permits the introduction of a discrete equivalent viscous-damping coefficient for each mode frequency, thereby effecting the frequency-independent characteristic of structural damping.

ANALOG-COMPUTER TECHNIQUE FOR SIMULATION OF DYNAMIC PRESSURE IN RE-ENTRY STUDIES (Correspondence)
F. W. Kasischke, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 80/82.

THE USE OF PASSIVE ELEMENT ELECTRICAL ANALOGS IN NUMERICALLY CALCULATING THE RESPONSE CHARACTERISTICS OF BEAMS
R. L. Barnoski, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 474/492.

. . . The analog circuits are force-current, velocity voltage electrical analogies which allow the study of transient, static and steady-state conditions. The beam systems considered are the cantilever beam and a beam with both ends clamped. . . .

COMPUTER SIMULATION OF THE ELECTRON MIXING MECHANISM IN ION PROPULSION
O. Buneman, et al., Presented at AIAA Electric Propulsion Conf., Colorado Springs, Colo., Rept. 63042, March 1963, 21 p., 6 refs., N63-17699.

ENGINEERS' MANUAL - DYNASAR
J. M. Watson, General Electric Co., Advanced Technology Labs., Schenectady, N. Y., Rept. 63GL36, 1 Jan. 1963, 114 p., 5 refs., N63-19197.

The Dynamic Systems Analyzer, DYNASAR, is a digital computer program for the study of dynamic systems. It uses simulation and response techniques similar to those of the analog computer. It is suitable for the evaluation of large, complex, linear and nonlinear systems describable by differential and algebraic equations. Computationally, DYNASAR is a general-purpose engineering-process program programed for the IBM 704 and 7090 computers.

Related Publications:

AN ANALOG COMPUTER REALIZATION OF THE EUCLIDEAN TOOLS
R. E. Keller, IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 564/570.

The compass and straightedge of Euclidean geometry offer many computational possibilities. Their analog computer realization as described here was developed for the study of the kinematics of machinery, but may be useful in several other areas.

MATHEMATICAL MODELING OF SOME TECHNOLOGICAL PROCESSES ON AN ELECTRONIC DIGITAL COMPUTER
I. S. Lyubchenko, et al., Joint Publications Research Service, Washington, D. C., JPRS-23041; OTS-64-21466, 3 Feb. 1964, 13 p., refs., Transl. into English of an article from Vestn. Mosk. Univ. (Moscow), no. 2, 1963, p. 37/43, Presented at the VPTI Meeting of the Mosgorsovnarkhoz, 29 June 1962, N64-14525.

. . . derivation of an algorithm that on the electronic digital computer, models the operation of a mechanized production line of electric heating elements. . . .

A SURVEY OF METHODS FOR DYNAMIC SYSTEM IDENTIFICATION AND RESEARCH IN OPTICAL COHERENCE
R. B. Mc Ghee, et al., University of Southern Calif., Engineering Center, Los Angeles, USCED-97-101; EE-22, March 1963, 89 p., 52 refs., N63-17065.

. . . first phase of a study of the feasibility of utilizing computers in the determination of mathematical models for dynamic systems are summarized. . . .

3A.683: Simulation of Thermal and Nuclear Processes

Included: Simulation for heat exchangers; Large blast simulator.

Not Included: Radiation hardening.

Principal Publications:

SIMULATION OF STEAM GENERATION IN A HEAT EXCHANGER
P. J. Hermann, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 53/57.

An analog-computer flow chart is developed for use in setting up a simulation of the steam-generation process in a heat exchanger. It is assumed in the paper that the rate of heat flow from the primary side of the heat exchanger to the secondary side is already known. The technique described considers only the process in the secondary side of the heat exchanger.

FEASIBILITY STUDY FOR A LARGE BLAST SIMULATOR. VOLUME I
A. H. Wiedermann, et al., IIT Research Inst., Chicago, Ill, Final rept. 1 May 1961 - 30 June 1962, Rept. no. T6035, 253 p., Jan. 1964, AD 427 807.

. . . to determine the most feasible means of obtaining a nuclear blast simulator which will reproduce the transient flow field associated with the 500 psig. over pressure range of large nuclear weapon detonations . . .

RIGOROUS TREATMENTS OF VARIABLE TIME DELAYS
S. G. Margolis, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 3, June 1963, p. 307/309.

A thermal plant usually consists of various pieces of heat transfer apparatus connected together by pipes. Simulation of the transport delay introduced by these pipes is frequently required. When the fluid velocity through the pipes is constant, the transfer function of the piping lag is easily derived.

3A.684: Simulation of Physiological Processes and Structures

Included: Simulation of heart action; Bio-simulators; Simulation of bio-chemical systems; Simulation of the human visual systems.

Not Included: Bionics (3B).

Cross References: Simulation of mental processes (3A.685).

Principal Publications:

SIMULATION OF A BIOLOGICAL SYSTEM ON AN ANALOG COMPUTER
E. C. DeLand, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 17/25.

. . . construction of a mathematical model of a large biological system. This method, based on Gibbs' free energy hypothesis, uses the format of mathematical programming, while the actual computation is accomplished by the method of steepest descent. The biological system chosen to exemplify the mathematical method was the respiratory function of the blood in the human lung.

SIMULATION AND ANALYSIS OF BIOCHEMICAL SYSTEMS. PART III. ANALYSIS AND PATTERN RECOGNITION
D. Garfinkel, et al., Commun. ACM, vol. 5, Feb. 1962, p. 115/118.

Programs for handling the reduction of the large amounts of data generated in solving the differential equations representing chemical systems are described. Two main programs, MASTER EDIT I and MASTER EDIT II, compress the information into library storage form, retrieve required information and recognize certain basic patterns.

SIMULATION AND ANALYSIS OF BIOCHEMICAL SYSTEMS. PART II. SOLUTION OF DIFFERENTIAL EQUATIONS
R. Larson, et al., Commun. ACM, vol. 5, Jan. 1962, p. 63/65.

Methods used for solving the system of first-order nonlinear differential equations corresponding to a system of chemical equations are described.

THE LOGIC OF BIOSIMULATION APPENDIX-THE DNA-PROTEIN CODE AND THE LINEAR REPRESENTABILITY OF n-DIMENSIONAL CONFIGURATIONS. A CONCEPT OF INTEGRATION CAPABLE OF INTEGRATING THE HEAVISIDE UNIT FUNCTION. PROOF OF THE AXIOM OF CHOICE
C. A. Muses, International Symposium on Biosimulation, 1st, Proceedings, Locarno, Switzerland, June 29-July 5, 1960, In: Aspects of the Theory of Artificial Intelligence, New York, Plenum Press, Inc., 1962, p. 115/163, 249/271, 37 refs., A63-17876.

AN INVESTIGATION INTO PATTERN INVARIANCE RECOGNITION CAPABILITIES OF THE HUMAN VISUAL SYSTEM
W. L. Harrison, Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, Aug. 1963, 111 p., AD 419 198.

. . . to find out how the human visual system performs pattern invariance recognition. A detailed study of the human visual system is made, a model of a portion of this system is derived, the model is simulated on a digital computer and tested to determine its pattern invariance recognition capabilities. . . .

ANALOG COMPUTER SIMULATION OF HEART ACTION
J. McLeod, et al., Commun. and Electronics, vol. 81, no. 64, Jan. 1963, p. 419/426.

The significance of the work described lies in the potential of the technique explored. . . . presented primarily to illustrate that potential, which, though interesting, is only a necessary first step in an investigation capable of extending knowledge far beyond its present bounds. . . .

3A.685: Simulation of Mental Processes

Included: Simulation in perceptual research; Simulation of cognitive processes; "Whirling Dervish"; Simulation in learning and recognition systems; Computer simulation of human thinking.

Not Included: Bionics (3B); Pattern recognition (2); Adaptive communications methods (2).

Cross References: Automata (3A.016); Simulation of biological structures (3A.684); Character reading equipment (3A.342).

Principal Publications:

DIGITAL SIMULATION IN PERCEPTUAL RESEARCH
E. E. David, Jr., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 322/328.

Evaluation of communications systems transmitting visual or auditory information is complicated since the final message destination is a human observer. It is the perceptual significance of transmission distortions which must form the basis for evaluation. Following this prescription, signal samples with specified distortions must be generated to serve as material for subjective evaluation . . . a digital computer can often be programmed to simulate the system and generate the desired samples. Several investigations using this technique have been carried out using a data translator to provide an input-output link to the computer. The significant properties of several band-saving codings have been so obtained . . . Potentially this technique can be extended to generate complex stimuli for psychological explorarion of perceptual mechanisms.

COMPUTER SIMULATION OF HUMAN THINKING
A. Newell, et al., RAND Corp., Santa Monica, Calif., Rept. no. P2276, 20 April 1961, 23 p., AD 432 469.

. . . a computer program, the General Problem Solver, instructed to solve the same problem as the human subject. . . . Computer simulation promises to provide a powerful tool for constructing and testing theories of complex cognitive behavior.

THE SIMULATION OF COGNITIVE PROCESSES: AN ANNOTATED BIBLIOGRAPHY
P. L. Simmons, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 462/483, 498 refs.

THE "WHIRLING DERVISH" A SIMULATION STUDY IN LEARNING AND RECOGNITION SYSTEMS
A. Hoffman, IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 153/160.

. . . An optical correlation device is described. Its function is to generate correlation data between two dimensional patterns and random line templates. The output of the device is paper tape containing the correlation data and sufficient flagging and sync. information to facilitate digital computer processing. The use of this device in conjunction with a digital computer is discussed as a simulation procedure for the evaluation and design of recognition systems. . . .

THE SIMULATION OF LEARNING AND DECISION-MAKING BEHAVIOR. ADDENDUM COMMENTS ON EVOLUTIONARY AND SELF-ORGANIZING SYSTEMS
G. Pask, International Symposium on Biosimulation, 1st, Proceedings, Locarno, Switzerland, June 29-July 5, 1960, In: Aspects of the Theory of Artificial Intelligence New York, Plenum Press, Inc., 1962, p. 165/210, 273/283, 46 refs., A63-17877.

A NET TO SIMULATE MORSE-CODE LEARNING
I. Barr, RAND Corp., Santa Monica, Calif., Jan. 1964, 33 p., AD 429 107.

. . . design of a neural net which can learn and recall six letters of Morse Code . . . The net, called MCN, can learn these coded equivalents in any order. By cascading the MCN with a sequence-recall net, a new net is created, called I, which is able to encode words after being taught the individual letter codes.

TECHNIQUES FOR EVALUATING OPERATOR LOADING IN MAN-MACHINE SYSTEMS MODIFICATION AND FURTHER EVALUATION OF A DIGITAL MAN-MACHINE SIMULATION MODEL
A. I. Siegel, et al., Applied Psychological Services, Wayne, Pa., July 1963, 59 p., AD 414 428.

THE SIMULATION OF COGNITIVE PROCESSES, II: AN ANNOTATED BIBLIOGRAPHY
P. L. Simmon, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 535/552.

. . . a supplement to the annotated bibliography that appeared in these Transactions last year. . . . to add 460 references that were not then included. These additional references bring forward the cutoff date for the cited publications to June, 1961, and expand the original bibliography by more than two hundred citations which were not available at the time the first installment was complied.

DIVISION 3A.7
GROUND BASED INFORMATION PROCESSING EQUIPMENT

This division contains references to Earth-based processing equipment for space electronics applications. The scope of this division was necessarily broadened beyond space communications applications because of integrated ground installation equipments already in operation or under development. The costliness and complexity of ground support requirements for various space crafts led to integration of installations, thereby providing capabilities for both the guidance and tracking of space craft and for command and communications links.

The layout of this division is tailored towards the current philosophy of integrated support. The first five sections are concerned with the general background of ground based equipment and the last three divisions are devoted to special space communications problems.

The general section (3A.70) is followed by a section (3A.71) on the interconnection of a large number of ground stations, required for world-wide networks of tracking and communications stations. It should be noted in this connection that ground networks for special space programs, such as the Project Mercury network, will be discussed in volume 4. Here we are concerned exclusively with the information processing equipment for the stations of such networks.

Section 3A.72 has references to the application of ground processors in special environmental conditions, such as aboard ships or in combat situations. These publications may give important information for the design of equipment for use on the surface of other celestial bodies.

Special control processors are in use on Earth as command and control processors for military applications and as control processors for the steering of large space-oriented antennas. Section 3A.73 deals with these problems.

Section 3A.74 presents a selection of references from the wide field of ground based navigational processors, primarily radar signal processors.

Communications control processors are the subject of section 3A.75. At present they find application in large scale military communications networks but the time is approaching when they will be required for the for the control of space communications links and of ground support networks for space communications.

The largest expansion of information processing equipment in ground stations is taking place in connection with the processing of the vast amount of telemetering data which are continuously received from space craft (3A.76).

Another important field for ground based information processors is the computer controlled automatic check-out processes and section 3A.79 contains references to this subject.

Section 3A.70

3A.700: Ground Based Processors in General

Included: Books and surveys about information processing in ground installations.

Not Included: General purpose processing activities.

Cross References: Data processors in general (Div. 3A.0)

Principal Publications:

GUIDED MISSILE COMPUTER SYSTEMS. A DDC REPORT BIBLIOGRAPHY
P.C. Rogers (comp.), Defense Documentation Center, Alexandria, Va., Biblography for Jan. 1958-Nov. 1963, Nov. 1963, lv., 117 refs., AD 422 847.

Section 3A.71

3A.710: Systems of Ground Based Processors

Included: PMR data handling system; Air Force satellite control facility; Space track systems; Processing network of the SFOF; Integrated mission control center (IMCC); AMR data handling system.

Not Included: Networks for special missions (4).

Cross References: Organization of data processing networks (3A.310)

Principal Publications:

AGGRESSIVE FLIGHT TEST THROUGH REAL-TIME DATA
F.R. Anderton, Jr., Proc. Nat. Telem. Conf., vol. 2, no. 11-2, May 1962.

. . . A history of real-time data monitoring is given showing the use of such data in enhancing safety of flight and increasing the return of significant data from flight tests. . . .

CONSIDERATIONS IN THE DESIGN OF A GROUND DATA CONTROL SYSTEM FOR REAL TIME TELEMETRY
E.C. Herrburger, Proc. Nat. Telem. Conf., vol. 2, no. 11-4, May 1962.

. . . incorporating: (1) Total data accessibility from remote sites to a central point, on command, (2) Maximum use of HF and cable transmission links in regard to bandwidth and data availability (3) A data call up method with address consistent with telemetry format and economical in bandwidth use. . . . also discusses real time control and distribution of telemetry data from a central point to display and control areas. . . . based on present needs and those forecast through 1967. . . .

THE ACCURACY OF AMR INSTRUMENTATION
H. P. Mann, RCA Service Co., Inc., Patrick Air Force Base, Fla., AFMTC TDR63 3, 17 Dec. 1962, 181 p., AD 406 859.

. . . discussion of the character of the errors encountered . . . errors of measurement for the various instrumentation systems. . . . determination of the accuracies of reduced data in position, velocity, and acceleration.

A REAL-TIME DATA HANDLING SYSTEM
W. Bauer, et al., Datamation, vol. 10, March 1964, p. 31/35, A64-16011.

. . . the Pacific Missile Range's real-time data-handling system of decentralized computers. The basic philosophy of the system is one of equipment decentralization with, however, an organization of communications and command control enabling centralized coordination. The advantages of this philosophy are increased system flexibility and reliability, and a reduction in communications requirements.

IMCC SYSTEMS AND PERFORMANCE REQUIREMENTS SPECIFICATION
R.S. Cronhardt, et al., Philco Corp. Western Development Labs., Palo Alto, Calif., Technical Report, Sept. 7, 1963, 330 p., 4 refs., N63-18255.

. . . Integrated Mission Control Center (IMCC) in support of the rendezvous phases of Project Gemini and Project Apollo . . . considers the display console, data processing, operational simulation, and training in GOSS (ground operational support system) interface and communication requirements.

TRACKING, TELEMETRY AND COMMAND STUDIES OF GROUND AND SATELLITE SUBSYSTEMS. VOLUME I: SUMMARY
F. Geradi, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR269 4110 01 13, vol. 1, SSD TDR 63 334, vol. 1, Dec. 1963, 13 p., AD 429 305.

Some conclusions are that the integration of command and telemetry with tracking provides a fundamental and substantial benefit in equipment costs, both at the ground sites and in the vehicle. The integration does compromise the performance of communications and tracking to some extent; however, the benefits derived from the use of a single antenna, receiver and transmitter on the ground and in space to accomplish all of these tasks will represent a simplification and significant economies over the conventional tracking arrangement, which involves a multiplicity of equipments. . . .

PRELIMINARY VERSION OF STANDARDS AND CONVENTIONS FOR THE UTILITY PROGRAM AREA OF THE SATELLITE CONTROL FACILITY
E. L. Griffith, System Development Corp., Santa Monica, California, Technical memo no. TM-1019/000/00, 6 Feb. 1963, 29 p., AD 297 782.

UTILITY PROGRAM DESCRIPTIONS MILESTONE 11 MULTICON
J.G. Hillhouse, System Development Corp., Santa Monica, Calif., TM 715 056 00, 15 July 1963, 343 p., AD 411 916.

. . . (1) to determine problems arising from multiple satellite operations; (2) to optimize the amount of activity by a choice of primary or alternate equipment; (3) to investigate the activity patterns obtained when the launch time of vehicle is varied; and (4) to list this information in the prescribed format. . . .

AMR INSTRUMENTATION HANDBOOK. VOLUME I. OPERATIONAL SYSTEMS
W.J. McKune, RCA Service Co., Inc., Patrick AFB, Fla., MTC-TDR-63-1, vol. 1, 1 Feb. 1963, lv., tables, AD 298 619.

. . . Radar tracking, Data processing systems, Optical tracking, Telemetering systems.

COMPUTER PROGRAM SUBSYSTEM INTEGRATION IN SUPPORT OF THE AIR FORCE SATELLITE CONTROL FACILITY
T.W. Polk, System Development Corp., Santa Monica, Calif., SP-1022, Jan. 10, 1963, 16 p., N63-22731.

. . . Typical real-time and nonreal-time data flow, including the kinds of data transmitted, are traced to and from a satellite, the tracking stations, and the Satellite Test Center in Sunnyvale, California. The major functions performed by the Computer program subsystems to support launch, orbit, and recovery operations are then delineated, with emphasis placed on the modular concept used in the development of individual subprograms and the background reasons . . .

OPERATIONAL SPACE TRACK SYSTEM AT COLORADO SPRINGS. PROGRAM SYSTEM
J.R. Stanfield, System Development Corp., Santa Monica, Calif., Rept. no. TM LX89 002 00, ESD TDR 63 639, vol. 3, 10 Jan. 1964, 24 p., AD 429 430.

. . . general description of the programs currently in the Space Track B-2 System.

AUGMENTED SATELLITE CONTROL FACILITY SYSTEM DESCRIPTION
S. Weems, System Development Corp., Santa Monica, Calif., TM1146 000 00, 1 April 1963, 93 p., AD 404 800.

. . . equipment subsystems are described in terms of their capabilities, functions, and primary usages . . . the principal activities performed by the SCF; i.e., telemetry, tracking command, and scheduling are explained in such a way that the previously described equipments are tied together into systems, with emphasis on the functional aspects of SCF operations. The STC is equipped to support six satellites simultaneously. Its data processing subsystems are divided into two main functional groupings: one, the "Bird Buffer complex" is vehicle oriented, and has eight CDC 160A computers, each of which can be individually assigned to an active satellite as a buffer; the other grouping is the off-line-computer complex, which used four CDC 1604 computers to do the main computational chores for the system.

A MULTIPLE SATELLITE REAL-TIME CONTROL NETWORK
V. White, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 4, Oct. 1963, p. 285/295.

The Satellite Control Facility (SCF) is composed of a central control station and a number of remote tracking stations, several of which contain dual station capability. The primary function of the SCF is to provide real-time communication and control for tests of space vehicles in a dense multiple satellite environment. This paper describes data flow within the SCF, the major functional subsystems involved, the resource scheduling and finally the manner in which the network is being controlled by a complex of computer generated real-time scheduling functions. . . .

AN APPROACH TO THE SEQUENCING OF RANGE OPERATIONS
C. Wisler, Pacific Missile Range, Point Mugu, Calif., PMR TM 63 4, 23 April 1963, 7 p., AD 402 612.

. . . attempting to use a digital computer as an aid in scheduling operations at the Pacific Missile Range. . . .

A COMPILATION OF PAPERS PRESENTED AT THE FOURTH JOINT AFMTC - RANGE USER DATA CONFERENCE
Air Force Missile Test Center, Patrick AFB, Fla., 28 Feb. 1963, 399 p., AD 429 095.

Contents: Error propagation . . . MISTRAM; The GLOTRAC system; Advanced range instrumentation ships . . . Data smooting; Applications of data filtering techniques to data processing . . .

DATA PROCESSING SYSTEM
JPL Space Prog. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 50/52.

. . . of the SFOF is designed around a central multi-computer configuration, which allows a high degree of flexibility and gradations of capability to adapt to different mission requirements . . . consists of three major subsystems; an IBM 7094, 7040, and 1301 disc file system, and a direct data connection between the IBM 7040 and 7094. The initial configuration, scheduled to be operational on January 1, 1964 . . . The second configuration, scheduled to be operational on January 1, 1965, will have all three systems backed up with full dual system. A block diagram Fig. 4 . . . Telemetry Processing System (TPS) is to convert telemetry data receiving in analog, digital, or composite subcarrier form to IBM compatible magnetic tape . . . Data Control and Display System . . . Computer Programming System.

Related Publications:

A REAL TIME TELEMETRY DATA TRANSMISSION SYSTEM
H.E. Rennacker, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 194/202.

. . . describes a modularly expansible system which can utilize either 3 kc voice lines, or HF radio facilities with a high degree of spectrum conservation.
It also includes remarks on the economic considerations of real time data transmission and the advantages of digital versus analog techniques. . . . One 300 bps line for synchronization . . . One 300 bps line for time. . . One 300 bps line has been assigned to handle the output of the RSEDM on the basis that this information rate would be less than 300 bps. . . . One 300 bps line should be more than adequate for Tracking Data requirements. Four 300 bps lines were assigned to handle the digitized FM telemetry data on the assumption that the lowest eight IRIG channels are being commutated at the maximum rates and digitized at six bits per sample. The unit marked TE-206T is a Kineplex transmitter with a capability of handling eight 300 bit per second input channels and using this information to modulate a 3 kc voice channel. . . .

THE HOWARD SAVINGS INSTITUTION — A CASE HISTORY IN REAL-TIME DATA PROCESSING
J. J. Feldman, IEEE Trans. Commun. Electronics, no. 67, July 1963, p. 367/372.

(No Title)
M. A. Franks, et al., System Development Corp., Santa Monica, Calif., TM795002 00, 5 Aug. 1963, 169 p., AD 415 100.

Outlines a series of validation and acceptance tests designed to show the capability of SCHOPS to schedule Satellite Control Facility (Satellite Tracking Annex and tracking station) operations and of CON to perform switch actions according to SCHOPS schedules or by means of overrides.

COMPUTER PROGRAM OPERATING INSTRUCTIONS FOR MULTICON (MODIFICATION AE) MILESTONE 7
J. Hillhouse, System Development Corp., Santa Monica, Calif., Rept. no. TM 1028 001 02, 2 Aug. 1963, 47 p., AD 415 475.

. . . Reports that MULTICON (1) investigates multiple satellite operations, (2) determines the problems arising from station-satellite assignments using a variety of launch times and equipment configurations, and (3) seeks solutions which will produce the optimum amount of activity. . . .

Section 3A.72

3A.720: Information Processing Equipment for Special Environment

Included: Combat information centers; Field computers; Tactical information processing systems; Shipboard information processors; Navy information processing equipment; DP equipment aboard range instrumentation ships; Mobile information processors.

Not Included: Space environment.

Cross References: Engineering of DP and equipment for extreme environmental conditions (3A.201).

Principal Publications:

THE SYSTEM ORGANIZATION OF MOBIDIC B
A.K. Chao, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 101/107.

MOBIDIC B, an all-transistorized militarized computer mounted in a standard army trailer, is described. It is a general-purpose, parallel, binary synchronous, fixed point, and duplexed data processing system containing two basic processors identical in characteristics internally tied together to the same system transfer bus. Both processors share a common set of input-output devices and each is capable of operating an independent program without interference. . . . In addition to the 8192-word high-speed core memory in each processor, there exists a 50 million-bit mass memory.

A MOBILE GENERAL-PURPOSE DATA-PROCESSING SYSTEM
C. Pilnick, IRE Trans. Instrum., vol. I-9, June 1960, p. 35/39.

A mobile data-processing system suitable either for expansion of existing telemetry data reduction facilities or as an independent data processor at remote test areas is described. . . . includes facilities for acquiring data from a wide variety of transducers, conditioning and normalizing signals, recording in both analog and digital form, processing selected channels for entry into an IBM 704 computer, data editing and tabular printout.

OPERATIONS CENTRAL AN/MSQ-19( )
Aeronutronic, Newport Beach, Calif., Quarterly progress rept. no. 10, 1 Feb.-30 April 1962, Publication no. U-1690, 10 May 1962, lv. incl. illus. tables, AD 277 848.

Combat information centers, Data processing systems . . . In programming and applications, a system utilizing situation material from exercise LUCKY ECHO was completed and tested. In display equipment, the Overlay Generator and Console Display units were integrated into system tests. . . . In data processing equipment, GRAPHDEN No. 1 and the Overlay Generator Controls No. 1 were completed and integrated into the system tests . . .

ENGINEERING DESIGN AND IMPLENTATION OF A MULTI-COMPUTER DATA PROCESSING SYSTEM FOR A NAVY COMMAND AND CONTROL CENTER
R.C. Gunderson, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 265/267.

MULTI-COMPUTER DATA PROCESSING SYSTEM FOR A NAVY COMMAND AND CONTROL CENTER
A. Hughes, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 262/264.

MINIPAC-A BATTERY POWERED, LOW COST FIELD COMPUTER
E. Lieblein, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 182/192.

ADVANCED RANGE INSTRUMENTATION SHIP DATA HANDLING
J.F. Mann, et al., Sperry Gyroscope Co., Great Neck, N.Y., 1963, 20 p., AD 407 756.

. . . problem of real-time interrelations. The central data-conversion equipment is described, including all the all-electronic converters for synchro-to digital, ac- and dc-to-digital, digital-to-synchro, and digital-to-ac and dc. . . . The paper shows how it has been possible to use conversion and recording equipment efficiently through the development of a special data sequence and recording format.

DIGITAL CONTROL OF A TACTICAL WEAPON WITH A SHIPBOARD G-P DIGITAL COMPUTER
J.B. Slaughter, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 257/261.

U.S. ARMY TACTICAL ADP SUBSYSTEMS DEVELOPMENT - THE MINIMUM PACKAGE
Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 235/238.

Related Publications:

DIGITAL SIMULATION OF A WEAPONS SYSTEMS DIGITAL CONTROL COMPUTER
W.B. Fritz, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 272/278.

Complex digital computers are now widely used as an integral part of many modern weapons systems. . . . necessary . . . to parallel the development of the weapon system itself. . . . Details of a simulation (written for the IBM 704) of a large scale digital computer to be used with a complex missile ground control system are provided. . . .

ENVIRONMENT STABILIZATION OF DATA PROCESSORS PROGRAM
R.E. Freeman, Hughes Aircraft Co., Fullerton, Calif., Rept. no. SCL4531, Quarterly rept. no. 2, 1 Sept.-30 Nov. 1963, 28 Feb. 1964, lv., AD 430 626.

. . . The design requirements for an environmental control system for data processors are summarized . . .

THE ARIS INSTRUMENTATION RADAR
R.I. Jacobson, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 60/63.

The ARIS Integrated Instrumentation Radar is a major subsystem of the first two Atlantic Range Instrumentation Ships for the United States Air Force. It is the latest and most sophisticated addition to the group of shipboard instrumentation radars available to the Atlantic Missile Range for down-range evaluation of test missile flights. . . . uses a number of modern radar techniques to make accurate position and multi-frequency target amplitude measurements on multiple high-speed targets located within its pencil beam. Both beacon and skin tracking are available. All data outputs are available in digital form for use in the instrumentation system digital computer. . . .

Section 3A.73

3A.730: Control Processors

Included: Military command and control computers; Missile control computers; Computer controlled antenna pointing system.

Not Included: Design of antenna steering mechanisms.

Cross References: Digital programmed antenna controllers (3A.450).

Principal Publications:

THE NIKE AJAX COMPUTER
W.E. Ingerson, Bell Labs. Record, vol. 38, Jan. 1960, p. 26/30.

. . . design and operation of the analog computer of the Nike Ajax guided-missile system are discussed. . . . The three phases of the missile guidance problem - the "prelaunch," "early-flight," and "steering" phases - are discussed.

AN AUTOMATIC ANALOGUE COMPUTER FOR MISSILE-HOMING INVESTIGATIONS
J.G. Thomason, Trans. Instrument Tech., vol. 12, March 1960, p. 16/21.

. . . operates and resets its parameters in response to an input program punched on paper tape . . . encodes its results and punches them on an output tape . . . The computer was developed to eliminate the routine work necessary in computer investigation of guided missile system performance and the tedious analysis of the computer results.

SOME CONSIDERATIONS IN SATELLITE COMMUNICATIONS SYSTEMS
B.C. Blevis, et al., Defense Research Telecommunications Establishment (Canada), DRTE 11 22, Jan. 1964, AD 430 769.

. . . Computer requirements for antenna control and data analysis are assessed. . . .

DATA HANDLING AND PROCESSING FOR CONTROL
B.B. Boone, American Institute of Aeronautics and Astronautics, Space Testing Conference, Cocoa Beach, Fla., 18-20 March 1963, Paper 63 099, 20 p., A63-17103.

Ancillary data and data-control signals include quality tags, acquisition and positioning data, operator control and display information (instrumentation readiness and mission status), and data "call-up" signals. The methods and techniques of handling and processing data are applicable to launch, flight, recovery (or impact) phases of space flight.

POINTING THE LINCOLN LABORATORY BUILDING B ROOF ANTENNA IN REAL TIME USING THE CDC 160-A COMPUTER
J.D. Drinan, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 62G3, 26 June 1963, 46 p., AD 410 546.

. . . CDC 160-A . . . controls, in real time, the laboratory's 30-foot telemetry antenna atop Building B in tracking artificial near-earth satellites. The program accepts input orbital parameters and generates new pointing angles (and range) every eight seconds.

DIGITAL DESIGN FOR AN ANTENNA POINTING SYSTEM
J.A. Githens, et al., Data Systems Engineering, vol. 18, Sept. 1963, p. 6/15, A64-10513.

Design and operation of the digital control and data-processing components of the Telstar antenna pointing system. Briefly described are the data processors, magnetic tape units, antenna digital control, track digital control, and tape switching unit. . . .

DIGITAL EQUIPMENT FOR THE ANTENNA POINTING SYSTEM
J.A. Githens, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1223/1252.

A PROGRAMMING SYSTEM FOR COMMAND AND CONTROL APPLICATION
M. Halpern, Lockheed Missiles and Space Co., Sunnyvale, Calif., Technical Report, LMSC-5-10-63-26, July 25, 1963, 54 p., refs., N63-22993.

. . . (1) the special problems and requirements of command and control computer programming . . . a macroprocessing programming system . . . A brief bibliography of current periodical literature . . .

COMPUTER CONTROLLED ANTENNA POINTING SYSTEM
JPL Space Prog. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 17/20.

Automatic antenna positioning system . . . at the Goldstone Tracking Station . . . Precomputed drive tapes for tracking during visibility periods were used almost exclusively during the 109 days of Mariner's trip to Venus . . . A study has been launched to define a tape drive system with expanded and more flexible capabilities for use throughout the DSIF and the Advanced Antenna System.

Related Publications:

LOGICAL DESIGN OF THE DIGITAL COMPUTER FOR THE SAGE SYSTEM
M.M. Astrahan, et al., IBM J. Res. Developm., vol. 1, Jan. 1957, p. 76/83.

. . . Design details for the arithmetic element, high-speed multiply, index registers, input-output, and magnetic-drum buffer are supplied.

DATA FOR DYNAMIC COMMAND
L.S. Christie, System Development Corp., Santa Monica, Calif., 10 June 1963, 11 p., AD 410 761.

Descriptors . . . Command and control systems . . . Communications systems, Data storage systems . . . Discusses information problems that arise in channels and sources external to command centers and between centers . . . information flow and the use of the data base within a command center . . .

HOW COMPUTERS ALIGN PHASED-ARRAY RADARS
A.G. Kramer, et al., Electronics, vol. 36, Nov. 15, 1963, p. 29/33, A64-11503.

. . . Two phased-array systems are discussed, the degree of automaticity of function, the speed of sequencing, and the techniques used in the instrumentation of each monitoring system differing in the two.

COMPUTER PROGRAMS
JPL Space Prog. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 23/26.

Satellite Rate Program to ascertain whether the angular velocity and acceleration encountered in a ha-dec antenna tracking an Earth satellite in any given orbit will violate the physical limitations placed on the antenna . . . DSIF Tracking Data Analysis . . . SDS 920 computer . . . Benson-Lehner plotter . . . Stereographic Projection Program.

Section 3A.74

3A.740: Navigational Processors

Included: Air traffic control computers; Radar data processors; Real time computers for radar signal processing; DME (distance measuring equipment) data reduction.

Not Included: Radar technology; Radar detection theory (2); Theory of navigational systems.

Cross References: Navigational input subsystems (3A.343); Simulation of aerospace flight operations (Sect. 3A.66); Signal processing subsystems (3A.580).

Principal Publications:

A LIBRARY OF BLIP SAMPLES FOR USE IN THE REALISTIC SIMULATION AND EVALUATION OF AUTOMATIC RADAR DATA PROCESSING SYSTEMS
C.M. Walter, et al., WESCON Conv. Rec., no. 4, 1958, p. 8/27.

The use of a combined special purpose analog and general purpose digital computer configuration, operating in real time, to obtain a library of radar video blip samples is discussed.

ORBITAL DATA HANDLING AND PRESENTATION
R.E. Putnam, Ballistic Research Lab., Aberdeen Proving Ground, Md., BRL Technical note no. 1265, June 1959, 15 p., AD 419 363.

The problem of detecting dark (passive) satellites, utilizing doppler techniques, is accompanied by a need for early satellite identification. The latter requirement necessitates an expeditious handling and classification of orbital data, and a presentation of results in ways that facilitate positive and immediate identification of "strange" satellites. The result of a preliminary study of prospective data handling and presentation procedures is presented. . . . Discussion is limited to a general, rather than to a specific treatment of the subject, because numerous pertinent details of instrumentation and orbital computation procedures are presently in a state of flux.

A MULTI-ADDRESSABLE RANDOM ACCESS FILE SYSTEM
E.A. Coil, IRE WESCON Conv. Rec., no. 4, 1960, p. 42/47.

. . . describes a drum memory intended for use as secondary storage in air traffic control computer. . . .

DIGITAL DATA HANDLING FOR THE AN/FPS-16 RADARS AT ABERPORTH
R.J. Chase, et al., Royal Aircraft Establishment (Gt. Brit.), Technical note no. TD 66, Nov. 1961, 24 p., illus. tables, AD 284 532.

Equipment . . . under development to record digital data from two AN/FPS-16 radars at Aberporth, and to convert the data into punched cards suitable for input to a DEUCE computer. Also described is an on-line computer which will be used to convert polar digital radar data to analog cartesian form and also to provide alternative polar data with origins remote from the radar.

A REAL TIME DIGITAL COMPUTER FOR RADAR CONTROL AND DATA PROCESSING
R.F. Day, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 82/85.

A DESIGN CONCEPT OF THE CONTROL AND COMPUTATION EQUIPMENT FOR A SPADATS PHASED ARRAY RADAR
F.C. Lisle, et al., Rome Air Development Center, Griffiss Air Force Base, N.Y., RADC TDR 62-161, May 1962, 72 p., incl. illus. tables, AD 278 483.

A large track and scan phased array radar designed for space tracking and detection functions will require a control unit of considerable complexity. This report attempts to analyze in some depth, the problems and solutions of the control unit of such a radar. Digital handling of the information on the high density satellite population expected in the next decade is described as well as the reasons for the choice of various techniques used. . . . a large general purpose computer is considered for the controlling element in this report, and the logical flow charts are developed for this type of mechanization.

REAL TIME METEOROLOGICAL SYSTEM FOR UNGUIDED ROCKET IMPACT PREDICTION
L.D. Duncan, Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex., ERDA-55, July 1963, 48 p., 19 refs., N63-19892.

An automatic real-time system is described which will be used for prelaunch impact prediction of unguided rockets at White Sands Missile Range, New Mexico. . . .

THE PRINCIPLES OF A DATA HANDLING SYSTEM FOR AIR TRAFFIC CONTROL
D. Halton, et al., In: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, Collected preprints, A64-12867.

. . . general facility requirements and design principles of a data handling system for air traffic control . . .

DME DATA REDUCTION
D. E. Holberg, White Sands Missile Range, N. Mex., Jan. 1963, 29 p., AD 410 281.

The ambiguity-resolution problem for a Distance Measuring Equipment (DME), using four independent modulation frequencies in the 500-kc region, is described in mathematical terms . . . two digital-computer routines providing for both ambiguity resolution and accuracy increase by averaging over the four phase measurements are developed . . .

DIGITAL AUTOMATIC RADAR DATA EXTRACTION EQUIPMENT
J. V. Hubbard, J. Brit. Inst. Radio Engrs., vol. 26, no. 5, Nov. 1962, p. 397/405.

. . . describes a method of extracting automatically the range and bearing of point source echoes in the video signals from a two-demensional radar (i.e., a radar scanning in range and bearing, or elevation, but not both), employing a digital ferrite core store for the necessary video storage. . . .

Related Publications:

MULTIPLE-TARGET DATA HANDLING WITH A MONOPULSE RADAR
M. Korff, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 4, Oct. 1962, p. 359/366.

Recognition and application of fundamental signal-gain relationships inherent to monopulse radars provide the means for determining the angle offset pattern and hence, angular position of all targets within the beam of a monopulse radar. With this method some 20 to 40 targets can be tracked with dynamic accuracies that approach the static accuracy of the radar, thus permitting precise determinations of their individual trajectories and cross sections. These determinations can be made in real or nonreal time, as desired, by using a small portion of the storage capacity of the digital computer normally utilized with range instrumentation systems to calibrate, store and process information in accordance with the data operations described herein. . . .

CONTINUOUS REGRESSION TECHNIQUES USING ANALOG COMPUTERS
A. I. Rubin, IRE Trans. Electronic Comp., vol. EC-11, no. 5, Oct. 1962, p. 691/699.

. . . A specific nonlinear problem, that of estimating the parameters of a missile trajectory, is also described.

CODING FOR TRACKING RADAR RANGING
T. C. Bartee, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Tech. Rept. 318, 11 June 1963, 45 p., refs., AD 416 649, N64-14028.

. . . A technique for determining the range for a tracking radar to a space vehicle is described in which an uninterrupted periodic binary sequence of very long period is used to modulate the radar output . . . Modulting sequences are listed for which the probability of computing an incorrect distance is minimum. Methods of logic design are presented for the required digital circuitry.

MAN AND MACHINE IN THE EXTRACTION AND USE OF RADAR INFORMATION
R. Benjamin, J. Brit. Instn. Radio Engrs., vol. 26, no. 4, Oct. 1963, p. 309/316.

. . . research and experimental program has been conducted over some years, aimed at the application of automation to radar data processing and, eventually, the automatic control of the radar's mode of operation. The paper outlines some of the requirements and problems in matching the man and machine to each other, to their input sources and to the appropriate output systems. . . .

BETTER DATA PROGRAM
H. Goldstein, General Electric Co., Syracuse, N.Y., Rept. no. 63098 63, 1963, 15 p., AD 407 764.

The General Electric BETTER (Best Estimate) Trajectory To Explot Redundant) data program has been designed to employ the maximum likelihood estimation technique to combine redundant measuring systems observing a vehicle in powered flight. This IBM 7090 computer program uses raw data, estimated biases, measured radar positions, timing information, the covariances on the random noise and survey data from each system to precipitate a weighted estimation . . .

ERROR PROPAGATION ASSOCIATED WITH STATION LOCATION
M. E. Kibbey, Philco Corp., Palo Alto, Calif., Technical note, Rept. no. WDL-TN62-14, 28 Feb. 1963, 17 p., incl. tables, AD 400 627.

. . . using a satellite orbit and tracking data. . . . A Philco 2000 Computer program is documented which, given the standard deviations in the tracking data, calculates the covariance matrix for the station coordinates.

GENERAL PURPOSE SATELLITE COMPUTER PROGRAM DESCRIPTIONS MILESTONE II. REFERENCE AND INTERCOMMUNICATION POOL (RIPOOL)
J. L. Laughlin, System Development Corp., Santa Monica, Calif., Rept. TM714 035 01, 20 Nov. 1963, 13 p., AD 427 837.

The RIPOOL provides a communication link between a function and its subroutines or between subroutines of a function. It contains many commonly used quantities such as geophysical constants. It provides storage for orbital parameters and other variables . . .

FLIGHT SPECIFIC COMPUTER PROGRAM DESCRIPTION ALARM CLOCK (ALACK) MILESTONE II
D.J. Persico, System Development Corp., Santa Monica, Calif., TM-L-742/006/00, 28 March 1963, 22 p., refs., AD 402 209, N64-15375.

Program Alarm Clock (ALACK) computes the positions of a satellite at specified time increments after acquisition by any of the following station-1(COOK), 5 (HULA), and 6 (BOSS). Usage, restrictions, storage requirements, validation tests, and timing are discussed.

AUTOMATIC RADAR DATA EXTRACTION BY STORAGE TUBE AND DELAY LINE TECHNIQUES
J.C. Plowman, J. Brit. Instn. Radio Engrs., vol. 26, no. 4, Oct. 1963, p. 317/328.

. . . extraction of radar target data . . . details of two experimental auto-extraction systems are given. One system involves the use of storage tubes and the other employs fused quartz delay lines as the necessary storage medium. . . .

NEW AND MODIFIED 1604 COMPUTER PROGRAMS IN SUPPORT OF AUGMENTATION (MILESTONE 5)
M.A. Rockwell, et al., System Development Corp., Santa Monica, Calif., 22 July 1963, 187 p., Rept. no. TM 1071 002 00, AD 414 904.

. . . (1) Orbit Adjust Table Maintenance (SOATAB): (2) Computer Orbital Elements (SGTTE); (3) Generalized Latitude to Time (SGLTT); (4) Generalized Advance Integration (SGAI); (5) Orbital Differential Equations (SDIFEQ); (6) Generalized Burn Integration (SGBURN); and (7) Geodetic Latitude Computation (SGDLAT) . . .

REDUCTION OF COMPUTATIONAL AND DATA TRANSMISSION REQUIREMENTS FOR TRAJECTORY ESTIMATION USING MULTIPLE SITES
F.C. Schweppe, Lincoln Lab., Mass. Inst. of Tech., Lexington, ESD TDR63 102, 23 Aug. 1963, 17 p., AD 416 742.

Space vehicles in free fall are often tracked from tracking sites located at different points on the earth. Two basic techniques for estimating the trajectory from the combined tracking data are discussed. These techniques are related to the maximum likelihood procedure but allow faster computation and do not require the transmission of all the data to a common data reduction center.

GENERAL PURPOSE SATELLITE COMPUTER PROGRAM DESCRIPTIONS MILESTONE 11 REFERENCE AND INTERCOMMUNICATION POOL (RIPOOL)
M.A. Tanous, System Development Corp., Santa Monica, Calif., Rept. no. TM714 035 02, 3 March 1964, 13 p., AD 437 620.

RIPOOL provides a communication link between a function and its subroutines or between the subroutines of a function. Also it is reported that RIPOOL contains many commonly used quantities such as geophysical constants and provides storage for orbital parameters and other variables.

ATHENA DOCUMENTATION HANDBOOK
G.M. Tyner, Aerospace Corp., San Bernardino, Calif., Rept. no. TOR169S3153 04 4, 16 Dec. 1963, 64 p., AD 434 167.

. . . tracking computer by Univac.

SPADATS SYSTEMS SUPPORT
Wolf Research and Development Corp., West Concord, Mass., ESD TDR 63-334, Jan. 1963, lv., AD 402 207.

. . . descriptions and operating instructions for a collection of programs. . .

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 31/38.

Stored program controller. . . . (SPC) used in the Mod II ranging equipment now has all the capabilities necessary for completely automatic control of ranging operations and other types of deep space tracking missions. . . . Capabilities which have been added recently include the arithmetic operations of shift, multiply, and divide, peripheral equipment such as the printer and the paper tape punch, and the control function of program interrupt.

FLUGSICHERUNGS-SIMULATORANLAGE FUR EUROCONTROL (Flight Safety Simulator For Eurocontrol) (In German)
Luftfahrttechnik Raumfahrttechnik, vol. 10, Feb. 1964, p. 56/59, A64-16048.

. . . a simulator which approximates the air traffic in a 2000-km-diameter region . . . central unit of the simulator is a digital computer . . . Described in some detail are the TR 4 digital computer employed, the display unit, radar simulation, and the data transmission unit.

Section 3A.75

3A.750: Communications Control Processors

Included: Real time control of switching centers; VADE, versatile automatic data exchange; AUTODATA message switching system; Message exchanges; Communications control centers.

Not Included: Topology of communications networks; Traffic analysis of communications networks; Design of switching centers; Ground stations for communications satellites (4A).

Cross References: Digital message handling units (3A.470); Electronic switching techniques for voice channels (3A.553); Simulation of communications networks and traffic (3A.650).

Principal Publications:

AUTODATA—RCA'S AUTOMATIC MESSAGE SWITCHING SYSTEM
J. L. Owings, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 616/623.

. . . describes the system design of an automatic store and forward type message switching center and will review the implementation of the system requirements with modern computer techniques. . . .

SYSTEM PERFORMANCE OF A COMMUNICATIONS CONTROL CENTER
J. Hoffman, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 244/250.

. . . The model formulated is focused upon two important criteria, response time and routing capability. These are determined as functions of processing capability, channel capacity, and system operation. . . .

THE DEFENSE NATIONAL COMMUNICATIONS CONTROL CENTER
C. D. May, Jr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 236/243.

A DATA REDUCTION AND ANALYSIS PROGRAM FOR THE "TELSTAR" SATELLITE COMMUNICATION SYSTEM
D. A. Aaronson, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 146/155.

Raw data. . . is processed on a High-Speed Digital Computer to produce tables and plots for evaluating communication and tracking performance. Data from the satellite and the Andover Earth Station is recorded in digital form on 7-track magnetic tape at the earth station, compressed, sent to a data center via Bell System data service, then reduced and analyzed on an IBM 1401-and 7090. Plots of various quantities are produced by a Stromberg-CArison Microfilm Printer. . . .

ITT 7300 A.D.X. MESSAGE AND DATA SWITCHING SYSTEM (In French)
O. de Gail, Onde Electr., vol. 43, no. 431, Feb. 1963, p. 153/169.

. . . Automatic Data Exchange System. . . designed to meet the various requirements of switching centers for both telegraph messages and data communications. The central part of this system consists of a 5 Mc/s stored program computer which can handle a large number of input and output circuits under the control of a "sequence break" device.

AUTOMATISCHE DATENUBERMITTLUNG BODEN-BORD-BODEN (Automatic Ground-Air-Ground Data Transmission) (In German)
J. Emser, Luftfahrittechnic Raumfahrttechnik, vol. 10, Feb. 1964, p. 53/55, A64-16047.

Delineation of the important considerations which must be taken into account in the planning and construction of an automatic ground-air-ground communications system using digital computers. Requirements are briefly considered for: communications channel, modulation techniques, transmission velocities, problems of error control. . . interrogation networks, and data presentation.

"VADE": A VERSATILE AUTOMATIC DATA EXCHANGE
D. R. Helman, et al., IEEE Trans. Commun. Electronics, no. 68, Sept. 1963, p. 478/482.

. . . ITT Federal Laboratories has developed a store and forward switching center capable of interfacing with both synchronous data and start- stop Teletype lines. This machine designated the ITT 525, fully utilizes its internal speed to eliminate the need for per-line and other special-purpose hardware. State of the art components, a novel system design, and miniature packages are used to provide a flexible and compact, as well as low-cost, system.

RANDOM ACCESS STATIONARY SATELLITE RELAY COMMUNICATION SYSTEM
Z. Prihar, Rec. Nat. Space Electronics Symp., no. 3.4, 1963.

. . . condensed version of a more extensive and detailed report. . . discusses a method of . . . a random access. . . system via active stationary satellite relays. . . . operation of the Control Center is analyzed. Two service channel transmission speeds have been considered, namely, 50 bits per second and 1200 bits per second. . . . predicted number of service channels. . . Queuing (waiting line) problems . . . alternative multiple access methods . . . substitution of an adaptive system . . .

REAL TIME CONTROL OF MILITARY COMMUNICATION SWITCHING CENTERS BY DIGITAL COMPUTERS
H. E. Ulfers, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 294.

Related Publications:

COMPUTER PROGRAM OPERATING INSTRUCTIONS FOR MULTICON (MODIFICATION AE) MILESTONE 7
R. Fey, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM-1028 001 00, 17 May 1963, 24 p., AD 416 679.

MULTICON (1) investigates multiple satellite operations (2) determines the problems arising from station-satellite assignments using a variety of launch times and equipment configurations, and (3) seeks solutions which will produce the optimum amount of activity . . .

MATCHING COMMUNICATION FACILITIES TO DATA PROCESSORS
C. F. Haugh, et al., IEEE Trans. Commun. Electronics, no. 67, July 1963, p. 429/435.

. . . There are a number of problems which arise when data-processing equipment is to be connected to communications lines in real-time systems. Four different solutions . . . are discussed. . . . the choice depends on the system complexity and size, information flow rates, and the central processor requirements.

THE ERDAA MOBILE DIGITAL DATA TRANSMISSION LABORATORY
J. J. Lamb, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 193/204.

. . . Communication links incorporating standard Army equipment . . . necessary that the same equipment serve a dual role; i.e., for conventional voice, teletype and facsimile communication as well as for digital data transmission at the FIELDATA rates of 75 x 2^n bits per second. . . .

SOME OPTIMUM PROCESSORS FOR MODERN COMMUNICATIONS AND CONTROL APPLICATIONS
A. H. Sepahban, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 768/792, 17 refs.

. . . examples reviewed include a DDA (digital differential analyzer) processor for a time-optimal attitude control system; a z-transform processor for a high performance digital autopilot control; and a special purpose stored-program processor for message switching, signal detection and error correction coding for the communications sub-system of a modern command and control system.

Section 3A.76

3A.760: Telemetry Data Processors

Included: Satellite telemetry and data processing; General purpose PCM telemetry processors; Decommutation ground station; Telemetry ground processors; Weather satellite data processing equipment.

Not Included: Design of telemetry links; Modulation methods (1); Ground stations for special space missions (4).

Cross References: Telemetry signal processing subsystems (3A.580).

Principal Publications:

AUTOMATIC DATA PROCESSING
C. J. Creveling, et al., IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 124/134.

. . . problems of reducing telemetry signals from scientific earth satellites are assessed . . . planning the data reduction facilities at the Goddard Space Flight Center . . . It was considered that the most powerful and versatile approach would be to translate the data into digital form and process it in large-scale general-purpose digital computers or in special computers designed for this kind of work. . . . sophisticated equipment is locally known as the STARS (Satellite Telemetry Automatic Reduction System) and will be in operation by mid-1962. . . .

A SYSTEM FOR AUTOMATIC COLLECTION AND PROCESSING OF STANDARD MAGNETOMETER DATA, AND THE CALCULATION OF THEIR POWER SPECTRUM
G. Gustafsson, et al., Kiruna Geophysical Observatory, Sweden, Annual Summary Report, Oct. 1, 1961-Nov. 30, 1962, April 10, 1963, 32 p., 3 refs., N63-17720.

. . . will sample all three components of the earth's magnetic field each 30 seconds. . . . A computer program has been developed for the reduction of the data. . . .

NIMBUS GROUND SYSTEM
L. Stelter, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review (1962), 20 p., N63-18608.

. . . consists of two command and data-acquisition (CDA) stations, one being established in Alaska and the other in eastern Canada . . . The Nimbus unique equipment includes a clock/command subsystem, equipment required for processing PCM telemetry data received from the spacecraft, equipment for processing the TV and IR data received from the spacecraft, and computers for additional data processing . . .

THE GENERAL PURPOSE COMPUTER AS A TELEMETRY GROUND STATION
C. A. Walker, Proc. Nat. Telem. Conf., vol. 2, no. 14-4, May 1962.

. . . use of small sized, high speed digital computers with suitable interface equipment offers an ultimately economically advantageous solution . . .

MULTICHANNEL REAL-TIME TELEMETRY DATA REDUCTION SYSTEM
J. K. Baird, et al., Army Electronics Research & Development Activity, White Sands Missile Range, N.M., AERDA 96, Dec. 1963, 17 p., AD 429 534.

The Real-Time Telemetry System, RTS, increases the capability of White Sands Missile Range (WSMR) telemetry data processing facilities by performing automatic linearization and scale-factoring in real-time. A preflight calibrator designed for use with the system, connects to the missile telemetry system and automatically calibrates the telemetry data transmission link from the transducer output to the RTS output. The system has the capability to reduce eight channels of telemetry data and provides both analog and digital output.

ADAPTIVE DECOMMUTATION GROUND STATION WITH COMPUTER CONTROL
J. A. Bauer, Proc. Nat. Telem. Conf., no. 11-5, May 1963.

Telemetry ground station support of multi-mission capability requires rapid and accurate control of the station input and output parameters. A system concept is developed for control of the video acquisition input parameters for synchronization and pattern recognition, for control of the decommutation output parameters for channel selection, and for control of decommutation data distribution to displays and reformatting equipment for real-time use. . . .

REAL-TIME TELEMETRY SYSTEM FOR AUTOMATIC DATA LINEARIZING AND SCALING
J. D. Cates, et al., Proc. Nat. Telem. Conf., no. 11-1, May 1963.

Development of the Real-time Telemetry System (RTS) for high-speed linearizing and scaling of telemetry data resulted from a requirement to increase the capability of White Sands Missile Range (WSMR) telemetry data processing facilities by performing automatic linearization and scale-factoring in real-time. A pre-flight calibrator, designed for use with the system, connects to the missile telemetry system and automatically calibrates the telemetry data transmission link . . .

GENERAL-PURPOSE PCM TELEMETRY PROCESSOR HANDLES PRESENT AND FUTURE MISSION REQUIREMENTS
C. B. Christie, IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 33/44.

. . . describes a general-purpose PCM data processor designed specifically to handle a wide variety of contemporary and anticipated PCM formats. . . .

TELEMETRY DATA PROCESSING FOR THE ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORY SATELLITE
R. Coates, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., Oct. 1963, 21 p., refs., N64-11812.

. . . PCM telemetry data rates of 1000, 8000, or 66,000 bits/sec, selectable by ground command . . . data storage for low-speed data (1000 bits/sec) plus about 40 percent ground station coverage of each orbit for data acquisition at any of the bit rates . . . processing lines convert the analog recordings of the PCM telemetry signals to digital magnetic tapes in computer format. The computer then performs quality control and decommutation of the data into separate digital tapes for each experimenter.

DRAPE PROCESSES SPACECRAFT TELEMETRY DATA IN REAL TIME
A. E. Corduan, et al., Space/Aeronautics, vol. 39, May 1963, p. 126/128, A63-18838.

. . . Drape (Data Reduction and Processing Equipment) system for Agena vehicles which processes 50-80% of telemetry test data in real time. . . . consists of three basic units, the telemetry signal conditioners, the telemetry data processor, and the computer. It accepts standard FM/FM telemetry, and PAM/FM up to 40-kc sampling rate.

TELEMETRY FACILITIES OF THE PACIFIC MISSILE RANGE, U.S.A.
B. O. Hicks, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 231/240.

. . . located at 11 ground sites, seven ships, and six aircraft. . . .

A STORED PROGRAM APPROACH TO MULTI-LINK PCM DECOMMUTATION
W. R. Key, et al., Proc. Nat. Telem. Conf., no. 11-3, May 1963.

. . . increased data rates . . . digital nature of the PCM telemetry signal suggests that techniques borrowed from digital computing systems might be employed to great advantage in PCM ground stations. . . .

A SYSTEM ORIENTED PCM GROUND STATION INCORPORATING DATA COMPRESSION
L. J. Lauler, Rec. Nat. Space Electronics Symp., no. 4.4, 1963.

. . . paper presents the design of a PCM decommutation system utilizing a core memory for program storage. . . . solution of the problems associated with on-line computer operations. . . . the "floating aperture" scheme has been found to be an effective T/M data compressor performing redundance reduction at moderate hardware cost. . . .

QUICK-LOOK REDUCTION OF RELAY TELEMETRY
C. Lundy, Space/Aeronautics, vol. 40, Oct. 1963, p. 124/128, A63-24936.

Description of a small, general-purpose digital computer used to edit, translate, and disseminate quick-look telemetry data from the Relay communications satellite . . . Two mobile data centers . . .

FLIGHT DATA REPORTING
R. E. McKann, et al., National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex., In its Mercury Proj. Summary including Results of the 4th Manned Orbital Flight, May 15-16, 1963, p. 231/242, 5 refs., N63-21964.

. . . During the progress of the Mercury Project, an effective method evolved for the postflight data processing, analysis of systems performance, and timely reporting of the results of the analyses . . .

PHASE II NIMBUS DATA-HANDLING SYSTEM
R. M. Madvig (editor), Stanford Research Inst., Menlo Park, Calif., Final rept., Jan. 1963, 190 p., AD 407 500.

. . . The design of the initial, phase I, system was reported in the first quarterly progress report, May 1962, and was essentially a less advanced system than the one reported here. . . . Phase II . . . cloud photographs, high resolution infrared data, and medium-resolution infrared data . . . Requirements for future improvements in the data processing system are reviewed. The need to reduce the cost of data transmission is emphasized as the most important future requirement.

A TELEMETRY DATA PROCESSING EQUIPMENT
E. S. Mallett, et al., Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 289/298.

. . . equipment . . . which processes telemetry data recorded on magnetic tape, to give a graphical record, or a digital output suitable for input to electronic computers. . . .

AUTOMATIC DATA PROCESSING OF WEATHER SATELLITE DATA
W. A. Marggraf, General Dynamics Astronautics, San Diego, California, AFCRL TDR63 243, 31 Jan. 1963, 50 p., AD 404 740.

WEATHER SATELLITE DATA PROCESSING
W. A. Marggraf, General Dynamics Astronautics, San Diego, Calif., Final rept., Aug. 1961-Jan. 1964, Rept. no. A DBB 64 002, Jan. 1964, 107 p., AD 433 731.

. . . Three working areas are documented: 1) automatic mosaicing of rectified TIROS video data, 2) infrared visual correlation of TIROS radiometer data, and 3) analysis of cloud distribution from TIROS rectified mosaics. . . .

THE REAL-TIME PROCESSING OF TELEMETRY DATA BY ALERT, A ONE MEGACYCLE COMPUTER (Technical Paper)
L. M. Newberry, et al., Northrop Corp., Anaheim, Calif., NSS-2579, March 31, 1963, 15 p., 9 refs., N63-16129.

. . . for prelaunch automatic checkout and in-flight monitoring of an airborne vehicle. The computer can also process this data from high-speed playback of magnetic tape for offline processing. The requirements of realtime telemetry data processing are given for various phases of vehicle validation. . . .

THE REAL-TIME PROCESSING OF TELEMETRY DATA BY ALERT, A ONE MEGACYCLE COMPUTER
L. M. Newberry, et al., Proc. Nat. Telem. Conf., no. 11-2, May 1963.

SATELLITE TELEMETRY AND DATA PROCESSING
H. B. Riblet, et al., Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 254/262.

. . . The satellite program at the Applied Physics Lab., The Johns Hopkins Univ. . . . emphasis on the telemetry and data processing requirements and instrumentation. The telemetry modulation systems used in the APL satellites include f.m./p.m., pdm/fm/pm/pam/fm/pm and pcm/fm/pm. The telemetry data are processed with the aid of a digital computer to automatically produce numerical listings or graphical plots. Some of the results obtained through the processing of satellite telemetry data are presented. . . .

THE MARINER II DATA PROCESSING SYSTEM
D. B. Sparks, Presented at AIAA Space Flight Testing Conf., Cocoa Beach, Fla., 18-20 March 1963, N63-17521, AD 407 761.

. . . data-processing facilities and equipment . . . spacecraft data communication scheme and modes of operation, and tracking and telemetry data-transmission formats. . . . preflight, flight, and postflight processing of Mariner tracking and telemetry data by the Central Computing Facility at the Jet Propulsion Laboratory, Pasadena, Calif. Computer programs and their frequencies of use during the flight are described.

SATELLITE DATA RECOVERY AND TRACKING SYSTEM FOR MANNED SATELLITE PROGRAM (News Release)
G. M. Truszynski, National Aeronautics and Space Administration, Washington, D. C., Aug. 16, 1963, 43 p., For presentation at the Conf. on Artificial Satellites, Blacksburg, Va., Aug. 12-16, 1963, N63-22013.

. . . accomplishments and plans in the area of Tracking and Data Acquisition for manned satellites are discussed . . . accuracy and its reliability and augmentations planned for the support of the upcoming GEMINI program is also discussed.

DATA ACQUISITION AND PROCESSING SYSTEM FOR THE NIMBUS METEOROLOGICAL SATELLITE
A. Wachtel, Proc. Nat. Telem. Conf., no. 11-4, May 1963.

. . . a new data processing system, now under test . . . system is designed to accept a wide variety of inputs—including FM, PCM-AM, PDM-AM, serial and parallel digital data . . . primary function is to format the input data for entry into a computer complex and the secondary task is to provide a means of displaying portions of the data in requisite format. . . .

INDIAN OCEAN STATION BUFFER (IOSB) MILESTONE 4
R. C. Wise, System Development Corp., Santa Monica, Calif., Rept. no. TM1245 000 00, 20 May 1963, 51 p., AD 408 553.

. . . CDC 160C computer system which provides a vehicle-oriented link between a remote tracking station, a 1604 computer and the Data Analysis/Technical Advisor, Data Presentation, and Multi-Ops complexes. The program system will process prepass and telemetry data for one vehicle and site each time it is operated. . .

AUTOMATIC PICTURE TRANSMISSION GROUND STATION INSTALLATION, OPERATION AND MAINTENANCE MANUAL
Fairchild Stratos Corp., Wyandanch, N. Y., Electronic Systems Div., Greenbelt, Md., NASA, Goddard Space Flight Center, 15 March 1963, 314 p., N64-18508.

The . . . (APTGS) provides facsimile reproductions of pictures transmitted from an orbiting meteorological satellite . . . will acquire the signals from the satellite when the satellite is more than 10^{o} above the horizon of the receiving station and when the direction antenna is oriented to the satellite position. The recorder reconstitutes the transmitted picture on a line-by-line scan basis . . .

DIGITAL INSTRUMENTATION SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 7/13.

The previous two articles on the digital instrumentation system (SPS 37-16, -20) gave a general description of the complete system. Details of the two general purpose digital computers used in the system will now be given. . . . a Scientific Data Systems (SDS) Model 910, and a SDS Model 920.

PROTOTYPE MAGNETIC TAPE STATION
Radio Corp. of America, Van Nuys, Calif., Data Systems Div., Final Technical Summary Report, May 1962-June 1963, 1963, 11 p., N64-13065.

A summary is presented of the development and production of a prototype magnetic-tape station for the Saturn ground-computer system.

DATA PROCESSING CENTER FOR SPACE EXPERIMENTS AT THE RADIO RESEARCH STATION
J. Brit. Instn. Radio Engrs., vol. 25, no. 6, June 1963, p. 524.

British equipment will be used for the first time to process the "raw" data received from the Anglo-American satellite to be launched by NASA next year. The satellite is at present known as S52 . . .

RADIO ASTRONOMY ANTENNAS AND PROCESSING OF RADIO ASTRONOMY DATA ANNOTATED BIBLIOGRAPHY OF SOVIET LITERATURE (PRELIMINARY), 1958-FEB. 1963
Library of Congress, Washington, D. C., Aerospace Information Div., AID B-64-11, 4 March 1964, 45 p., refs., AD 431 787, N64-16779.

Related Publications:

A REAL TIME TELEMETRY DATA TRANSMISSION SYSTEM
H. E. Rennacker, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 194/202.

. . . describes a modularly expansible system which can utilize either 3 kc voice lines, or HF radio facilities with a high degree of spectrum conservation. . . .

METEOROLOGICAL APPLICATIONS OF NIMBUS DATA
E. G. Albert, In NASA, Goddard Space Flight Center, Greenbelt, Md., Proc. of the Nimbus Program Review, See N63-18601 17/32, Paper 3, 1962, 29 p., 11 refs., N63-18604.

OPERATING PROCEDURES FOR THE TRACKING STATION PCM TELEMETRY PROGRAMS (MILESTONE 7)
C. Bustya, et al., System Development Corp., Santa Monica, Calif., TM1363 000 02, 16 Aug. 1963, 46 p., AD 418 999.

. . . detailed statement of the operating procedures, and illustrations of the on-line listings. The procedures cover non-real-time and real-time functions. Only the real-time procedures are not sequenced according to a usage pattern, since the events they relate to occur in a random fashion.

OPERATING PROCEDURES FOR THE TRACKING STATION PCM TELEMETRY PROGRAMS (MILESTONE 7)
C. Bustya, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM136 000 03, 9 Sept. 1963, 49 p., AD 422 622.

OPERATIONS PLAN 13-63. TELEVISION OBSERVATIONAL SATELLITE (TIROS H)
A. G. Ferris, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., Dec. 1963, 41 p., N64-17608.

. . . activities concerned with Project TIROS . . . Included are: . . . computing center operations.

DOCUMENTATION OF THE TIROS III DATA REDUCTION PROGRAM
L. Fried, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., Dec. 18, 1962, 90 p., N63-23038.

. . . (1) detailed breadkdown of the program's executive routine, including the generation of the Final Meteorological Radiation Tape (FMRT); (2) subroutines which give calling sequence, purpose and method of solution; (3) sense switch and indicator bit settings; (4) diagnostic counters used in program; (5) program inputs which include documentation card, radiation tape documentation record, and format of the orbital tape; and (6) flow chart of subroutine "DIRECT".

OPERATING INSTRUCTIONS FOR THE PARAMETER TEST SYSTEM, MILESTONE 7
C. R. Frey, et al., System Development Corp., Santa Monica, Calif., Rept. no. TM1138, 25 March 1963, 50 p., AD 410 191.

. . . consists of three programs (1) the Reference Pool simulator (SRPS) . . . (2) Test Control (STCP), sets additional environment such as tables, items, and core locations before and during program's operation, provides dumps of tables, programs, and core areas before, during and after the test . . . (3) Data Reduction (SDRP), selectively formats and list the test outputs.

IRIG TIME CONTROLLED PROGRAMMER
R. H. Huebel, Air Force Missile Development Center, Holloman AFB, N. Mex., MDC TR 63 2, Sept. 1963, 39 p., AD 421 597.

. . . a decoder and programmer. This presentation is concerned with the input data formats, the available outputs and the theory of operation for the system. . . .

1604 SIMULATION PROGRAM DESCRIPTIONS MILESTONE XI, THE SIMULATED TELEMETRY DATA GENERATION CONTROL PROGRAM (STGR)
J. Ng., System Development Corp., Santa Monica, Calif., TM L734 024 00, 15 March 1963, 31 p., AD 405 132.

. . . designed to provide realistic telemetry data . . . Additional capability to simulate PAM and PCM telemetry data (exclusive of special vehicle-specific payload telemetry) will be incorporated . . .

COMPUTER OPERATING INSTRUCTIONS FOR THE SIMULATED TELEMETRY DATA GENERATION PROGRAM (STSTLM) MILESTONE 7
J. Ng, System Development Corp., Santa Monica, Calif., TM734 035 01, 6 June 1963, 58 p., AD 411 645.

. . . designed to generate a simulated tape (TLM-tape) containing input data for the TLM computer at the tracking station. The STSTLM program will also generate the system time code word (STCW) and the Input Control Word in exactly the same format as they are normally input to the TLM computer.

MILESTONE 11, PCM TELEMETRY PASS PROGRAM VOL. 1. TELEMETRY DATA INPUT AND SYNC ANALYSIS
D. J. Persico, System Development Corp., Santa Monica, Calif., Rept. no. TM1551 001 00, 11 Nov. 1963, 11 p., AD 427 908.

. . . digitized PCM telemetry data received from the TDP (Telemetry Data Processor) . . . The module SYNC of this program locates the most probable position of the payload or status synchronization bit pattern in the received data stream and the module SYNCA verifies that the synchronization bit pattern is still valid. . . .

A TRACE-IDENTIFIER UNIT FOR FM-FM PROCESSING
A. Simon, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 15/24.

. . . unit provides a complete checkout of the FM-FM system wiring and provides identification of each trace on the record. . . .

Section 3A.79

3A.790: Missile Test and Checkout Processors

Included: Automatic checkout techniques; ACE = automatic checkout equipment; Launch control processors; VATE = versatile automatic test equipment; Digital control equipment for missile checkout; Diagnosis procedures in checkout.

Not Included: Test procedures.

Cross References: Diagnostic computer routines (3A.170).

Principal Publications:

OPERATIONAL CRITERIA FOR AUTOMATIC MISSILE READINESS TESTING
S. I. Firstman, IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 251/259.

. . . is that set of tests performed regularly for the purpose of detecting failures that have occurred in the missile and launch equipment. This is done in order to maintain a high state of operational readiness, measured in terms of readiness probability. . . .

DIAGNOSIS IN AUTOMATIC CHECKOUT
S. E. LaMacchia, IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 302/309.

. . . summarizes several approaches to the problem of isolating faults in a complex system. . . .

QUANTITATIVE TEST TECHNIQUES FOR ADVANCED AUTOMATIC CHECKOUT
M. C. Peterson, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 240/250.

High-speed, digital, internally-programmed, automatic checkout equipment is a powerful test tool whose impact has not yet been felt in testing large complex systems. It has, in certain ways, much higher test capabilities than either a sequentially programmed machine or a human operator. For these capabilities to be harnessed, new test techniques are required to ensure that failures or weaknesses are detected and separated from normal drifts. . . .

SURVEY OF CURRENT FAULT ISOLATION TECHNIQUES
B. B. Gordon, et al., Proc. Seminar on Automatic Checkout Techniques, Battelle Memorial Inst., Columbus, Ohio, Sept. 1962.

E. St. Clair
THE DIAGNOSIS PROCESS
S. I. Firstman
CRITERIA FOR EVALUATING PRELAUNCH TESTS
S. Seshy
THE FUTURE OF DIAGNOSIS

AUTOMATIC CHECKOUT TECHNIQUES
W. A. Rose, et al., Proc. Seminar on Automatic Checkout Techniques, Battelle Memorial Inst., Columbus, Ohio, Sept. 1962.

W. A. Rose
PERFORMANCE PREDICTION TECHNIQUES
M. Moll
ALTERNATIVE TECHNIQUE FOR OBTAINING PERFORMANCE FIGURES
A. T. Kneale
A SURVEY OF FAILURE PREDICTION METHODS
C. W. Hamilton
RELIABILITY AND FAILURE PREDICTION
J. J. Coleman and R. E. Wesel
READINESS MODELS FOR IMPERFECT MAINTENANCE

RESEARCH GUIDELINES FOR DIGITAL COMPUTER-CONTROLLED SYSTEMS FOR CHECKOUT AND FAULT ISOLATION
C. Beckman, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1064/1073.

COMPUTER-CONTROLLED AUTOMATED TESTING ON THE POLARIS PROGRAM
B. W. Furstenau, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 895/909.

TEST PROCEDURE LANGUAGE DEVELOPMENT
G. P. Gollomp, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1327/1334.

. . . For preparing test procedures, a compiler system is required by test engineers to write test statements in a restricted English language. . . . this paper will be devoted to the discussion of test language development, compiler design, and influence on test system organization. . . .

DESIGN OF A MULTIPURPOSE DIGITAL CONTROL COMPUTER
D. W. Greene, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1074/1089.

. . . describes the Martin automatic rapid test and control (MARTAC) computer, which was designed . . . to meet a broad range of missile checkout and launch control problems. . . . An engineering prototype was built, debugged, and demonstrated. . . .

UTILITY PROGRAM DESCRIPTIONS MILESTONE 11. TEST CONTROL PROGRAM (STCP) FOR THE PARAMETER TEST SYSTEM
E. L. Griffith, System Development Corp., Santa Monica, Calif., TM715 041 00, 25 April 1963, 95 p., AD 413 886.

. . . A Parameter Test is a controlled run of an object program to verify or debug the coding and the logical design of the program's function. An object program is defined as a segment of a computer system; e.g., a program, subroutine, or even a string of few instructions. Such a test consists of: (1) artificially creating an environment in which the object program can be operated in a known and controlled manner (2) operating the object program, and (3) sampling data during the run for evaluation of the object program's performance. . . .

SPERRY ACE—AUTOMATIC CHECKOUT EQUIPMENT FOR MISSILE SYSTEMS
V. Y. Jensen, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 299/304.

. . . a unique digital computer-controlled automatic checkout system providing all of the loads, stimuli, and marriage circuitry required to completely test such complex electronic equipment as missile guidance systems, aerospace systems, and instrumentation systems. . . .

AUTOMATIC CHECKOUT AND LAUNCH CONTROL OF MANNED OPERATIONAL SPACECRAFT
L. S. Klivans, et al., In: Aerospace Electrical Society, Annual Aerospace Electrical/Electronics Conference, 21st, Los Angeles, Calif., Oct. 9-11, 1963, North Hollywood, Western Periodicals Co., 1963, p. 89/128, 7 refs., A64-17247.

. . . a computer-controller system representing highly versatile data-handling, processing, and display capabilities. This system definition makes maximum utilization of the spacecraft on-board equipment, such as PCM telemetry and digital command guidance systems, in order to allow real-time integration and evaluation of all airborne equipments and also the astronauts during the prelaunch and countdown phases. . . .

COMPUTER CONTROLLED LAUNCH CONTROL AND CHECKOUT OF OPERATIONAL SATELLITE SYSTEMS
L. S. Klivans, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1249/1261.

NIMBUS COMPUTER SYSTEM DESIGN
H. G. Klose, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 23 p., See N63-18601 17/32, Paper 20, N63-18621.

. . . Control Data Corporation (CDC) 160A computer as part of the fixed ground-station system for Nimbus spacecraft integration and test procedures. The function of the computer is to perform the required computations, logic, formats, routing, and display of reduced results, so that Nimbus project personnel may know the "state vector" of the satellite and all of its subsystems during environmental tests . . .

VATE—A LARGE-SCALE COMPUTER-CONTROLLED TESTING SYSTEM (AN/USM-176)
V. Mayper, Jr., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1308/1319.

. . . automatically performs fault detection, fault isolation to the plug-in module or inertial component, and full acceptance testing, of inertial guidance equipment. . . .

A DATA COLLECTION AND ANALYSIS SYSTEM
I. S. Oscar, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1438/1445.

. . . for use in environmental checkout of instrumented satellites. Included is an on-line computer for real time analysis and monitoring. Centralization of data flow permits handling of several large scale experiments simultaneously. Operation is on a 24 hour day bais. The stringent reliability goals have been met . . . used to assist in the checkout of satellites during the environmental test phase . . . performed at the Goddard Space Flight Center in Greenbelt, Maryland . . .

DIGITAL DATA SYSTEM FOR AUTOMATIC CHECKOUT OF SPACECRAFT
W. E. Parsons, et al., Presented at the AIAA Space Flight Testing Conf., Cocoa Beach, Fla., March 18-20, 1963, 21 p., N63-17661.

The PACE-S/C digital data system . . . consists of five subsystems: the pulse-code-modulation ground-station subsystem, the computing subsystem, the display and control subsystem, the data transmission subsystem, and the onboard associated equipment (data acquisition and signal stimuli generator) subsystem. . . .

AUTOMATIC-DATA SYSTEMS FOR SYSTEMS TEST APPLICATION
JPL Space Prog. Summ., vol. 6, no. 37-20, Jan./March 1063, p. 68/70.

Two identical automatic-data systems are being planned for supporting systems testing in the Spacecraft Assembly Facility (SAF) area at JPL and in the launch checkout facility at AMR. Each system contains a medium-sized, high-speed computer to process both telemetry and hardwire data (direct-access spacecraft or ground equipment data) from two simultaneous spacecraft systems tests . . . Initial application of the data systems is planned for the Mariner Mars 1964 Project . . . The system block diagram (Fig. 1) outlines the major systems components.

A COMPUTER-CONTROLLED CHECKOUT SYSTEM FOR SCIENTIFIC INSTRUMENTS
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 47/49.

The Mariner C operational support equipment (OSE) is designed for both manual OSE operation and computer-controlled testing. The computer system is illustrated in Fig. 21. This system consists of a Digital Equipment Corp., (DEC) PDP-4B computer and a peripheral console. The PDP-4B is a single-address, parallel, binary machine operating with an 18-bit word length. Standard features include stored program operation, a random access magnetic-core memory, a complete order code, and indirect addressing.

Related Publications:

USING DIGITAL COMPUTERS IN THE DESIGN AND MAINTENANCE OF NEW COMPUTERS
A. L. Leiner, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 4, Dec. 1961, p. 680/690.

DIGITAL COMPUTER CHECKOUT ON INERTIAL NAVIGATION SYSTEMS
J. L. Henry, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 568/574.

Checkout techniques used in operational systems by the Armed Services are described. These systems use a digital computer to control checkout operations and precision calibrations, and to perform associated computations. The use of the system digital computer greatly simplifies the required highly precise automatic checkout equipment. . . .

A CONTROL COMPUTER FOR MISSILE TEST AND LAUNCH SYSTEMS
L. O. Johnson, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 72/76.

. . . The trend in missile electronic support equipment requirements is discussed briefly. A control unit, capable of being used in missile test and/or launch systems, to meet these increasing requirements is described. The description covers the control unit first in a general manner by discussing its memory, word structure, clock rate, etc., followed by a more detailed description of its input/output capabilities. . . .

THE DIAGNOSIS OF ASYNCHRONOUS SEQUENTIAL SWITCHING SYSTEMS
S. Seshu, et al., IRE Trans. Electronic Comp., vol. EC-11, no. 4, Aug. 1962, p. 459/465.

. . . problem of automatically testing a sequential switching circuit. It is assumed that the sequential circuit is nonclocked in order that the same automatic tester may be used for a wide class of circuits. The program for the tester is to be generated by an IBM 7090 computer from the logical description of the circuit to be tested.

IMPLEMENTATION OF LOGIC
R. W. House, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 297/302.

In the development of computer programs for automatic checkout and the simplification of switching networks, certain simple logical routines occur frequently. Only a few such routines are needed to cover a large number of situations. A concise list or catalog of such routines is given in this paper. The shortest and simplest of these routines are called micro-programs. . . .

COMPUTER LOGIC TESTING BY SIMULATION
G. N. Stockwell, IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 275/282.

. . . describes one such method which utilizes an IBM 704 to simulate the logical equivalent of a specific computer under development by Nortronics Division of Northrop Corporation.

. . . eliminates much of the expensive checkout time usually required. . . .

SATELLITE CONTROL FACILITY EQUIPMENT AUGMENTATION. DESIGN CRITERIA: SATELLITE TEST ANNEX DATA SUBSYSTEM
Aerospace Corp., Los Angeles, Calif., 31 Aug. 1962, 17 p., AD 404 199.

. . . data-handling equipment of the Satellite Test Annex (STA) . . . supports the satellite control, acquisition, tracking, commanding, telemetry, and STA control operations as required for each applicable project. It will be integrated with the timing subsystem, control consoles, and the inter- and intra-facility communications subsystems.

COMPUTER TECHNIQUES FOR SOLVING ELECTRIC CIRCUITS FOR FAULT ISOLATION
R. S. Berkowitz, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1090/1099.

. . . use of a digital computer for automatic checkout and fault isolation of electrical networks. The work reported here represents a refinement and extension of work done in a previous paper. . . .

DIVISION 3A.8
INFORMATION PROCESSORS IN AEROSPACE VEHICLES

Spaceborne computers developed from aircraft flight computers; consequently, the first three sections of this division include many references to airborne flight computer technology.

Section 3A.84 is concerned with space guidance and control computers and section 3A.85 deals with spaceborne processors for information processing of science data and of command signals.

Section 3A.80

3A.800: Flight Computer Technology

Included: Airborne analog computers; Digital computers for aircraft use; On-board computers for space craft.

Principal Publications:

FLIGHT TEST INSTRUMENTATION
M. A. Perry (Editor), New York, Pergamon Press, 1961, 153 p.

. . . Instrument transducers. . . . aircraft telemetry system. . . magnetic tape recording in flight testing. . . Aircraft data reduction techniques. . . . 15 papers listed comprise the edited Proceedings of the First International Symposium sponsored by the Department of Flight, College of Aeronautics, Cranfield, in 1960. . . .

DIGITAL COMPUTERS FOR AIRCRAFT
P. A. Hearne, Flight International, vol. 85, Feb. 20, 1964, p. 288/291, A64-15450.

. . . principles and applications of the airborne digital computer. . . . advantages of the digital computer when compared to the analog computer are seen to include accuracy, reprogramming capability, reliability, and the greater possibility of microminiaturization. The Autonetics D37B computer, which is used for the guidance and autopilot of the second generation Minuteman missile, is briefly described and the important differences between typical digital systems for military and civil aircraft are defined. . . .

DIGITAL COMPUTERS FOR AIRCRAFT USE
J. R. Kelsey, Sperry Engineering Review, vol. 16, Winter 1963, p. 45/48, A64-15098.

General discussion of the computation requirements of aircraft and airborne weapons systems. . . . data processing, flexibility, input/output, and multiplexer requirements are delineated. . . .

PRACTICAL ASPECTS OF DATA PROCESSING AND ENCODING FOR SPACE COMMUNICATIONS
G. E. Mueller, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 471/487.

. . . Communications from spacecraft. . . Surveyor. . . Aeros. . . Ranger. . . OAO. . . Relay. . . Telstar. . . discussing methods for processing and encoding data from spacecraft. . . Four factors must be considered in the process of translating measurements and events at a spacecraft into a form suitable for telemetry transmission; filtering, encoding, the choice of format for this code, and the capability for decoding. . . . each of these will. . . be reviewed. . .

SPACE RENDEZVOUS, RESCUE, AND RECOVERY. A DDC ABSTRACT COMPILATION
P. C. Rogers, Jr., Defense Documentation Center, Alexandria, Va., Aug. 1963, lv., 570 refs., AD 410 085.

. . . Citations are included for reports catalogued by DDC from 1953 to June 1963 and are restricted to unclassified, unlimited references. . . rendezvous guidance, control and/or propulsion. . . control center operations; simulation techniques; spaceborne computers and data processing. . . communications and telemetry. . .

GUIDED MISSILE COMPUTER SYSTEMS. A DDC REPORT BIBLIOGRAPHY
P. C. Rogers (Comp.), Defense Documentation Center, Alexandria, Va., Bibliography for Jan. 1958-Nov. 1963, Nov. 1963, lv., 117 refs., AD 422 847.

FUTURE OF ON-BOARD COMPUTERS FOR SPACE VEHICLES
G. H. Smith, Autonetics, Downey, Calif., June 1963, 15 p., AD 421 162, AD 417 402, N63-21439.

. . . On unmanned vehicles, primary uses have been for timing and control; several manned systems with on-board computers are in development. . . .

FUTURE OF ON-BOARD COMPUTERS FOR SPACE VEHICLES
G. H. Smith, IN: 2nd Manned Space Flight Meeting. New York, American Institute of Aeronautics and Astronautics, 1963, p. 151/158, A63-19002.

AIRBORNE ANALOGUE COMPUTERS
J. G. Wright, Canadian Aeronautics and Space Journal, vol. 10, Feb. 1964, p. 25/31, A64-14810.

. . . application of analog computers to future aircraft navigation systems. . . The merits of the analog computer are briefly illustrated in terms of refinement of design, accuracy, miniaturization, and reliability. . . to provide for the entire flight control loop for a variety of aircraft sizes and roles, required are some 40 basic building blocks. . . .

Section 3A.82

3A.820: Flight Computer Engineering

Included: Failure prevention in flight computers; Redundancy in space craft computers; Components and subsystems in flight computers; Microelectronics for spaceborne computers.

Not Included: Environmental hardening of space computers.

Cross References: Computer engineering for extreme environmental conditions (3A.201).

Principal Publications:

AN APPROACH TO AIRBORNE DIGITAL COMPUTER EQUIPMENT CONSTRUCTION
P. E. Boron, et al., IRE Trans. Prod. Techniques, vol. PT-4, June 1959, p. 18/21.

A method of building airborne digital equipment which makes use of the modularized etched-wiring plug-in philosophy and which utilizes an all-etched-wiring harness to accomplish the entire complex of connections between plug-in units is discussed.

MICROMINIATURE ELECTRONIC CIRCUITRY FOR SPACE GUIDANCE
E. Keonjian, IRE WESCON Conv. Rec., June 1959, p. 92/99.

The results of a feasibility study of microcircuitry as applied to one part of a space guidance digital computer is described. A full adder consisting of seventeen individual circuits has been built within a total volume of 0.5 cubic inch as one phase of this study.

APPLICATION OF MICROMINIATURIZATION CONCEPTS TO SPACE GUIDANCE COMPUTERS
E. Keonjian, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 1/5, 19 refs.

AN ULTRA-RELIABLE COMPUTER FOR MISSILE AND SPACE APPLICATIONS
R. P. Blixt, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 91.

Abstract Only. Physical Description and Characteristics of the ADD Computer. . . . has an electrically alterable, thin-film NDRO memory for program and trajectory constants storage and a scratch pad DRO memory. . . . weighs 88 pounds, occupies 1.1 cubic feet . . .

SUBMINIATURE COMPUTER DESIGNED FOR SPACE ENVIRONMENTS
W. A. England, Rec. Nat. Symp. Space Electronics Telemetry, no. 7.1, Oct. 1962.

. . . The need for. . . high reliability and lightweight has generated requirements for a new breed of inertial navigational digital computers. . . . use of a solid state non-destructive readout ferrite memory. . . constructed of subminiature (micro) components interconnected by welding and casted into modules. . . . designed to give a maximized component count, power requirement, size, and weight. . . . weighing approximately 20 pounds, requiring 46 watts of power and having, as an example, and ADD cycle time of 12 microseconds. . . .

A CONCEPT FOR A MODULAR SPACE-BORNE COMPUTER
F. Sanderson, Rec. Nat. Symp. Space Electronics Telemetry, no. 8.5, Oct. 1962.

DISPLAY AND CONTROL IN MANNED SPACE VEHICLES
A. Shulman, In: Advances in the Astronautical Sciences. Vol. XI, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 271/298, 50 refs., A64-11455.

. . . system plan has evolved that features closed-circuit television for presenting either symbolic displays derived from vehicle sensor data or television picture video from vehicle TV cameras. . . . The control unit is comparable to a special-purpose digital computer facility. . . .

A COMPACT 166-KILOBIT FILM MEMORY
R. D. Turnquist, et al., IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 63/72.

. . . The theory, design, and operating characteristics of a 166 thousand-bit thin film memory system are presented . . . Although this compact memory system is an integral part of a guidance and control computer designed specifically for an aerospace application, the design is adaptable to other military control computers. This random-access, parallel-readout, word-organized memory system includes a 256-word, 24-bit destructive readout (DRO) memory. . . Cycle time in the program mode is 3.0μ sec, and access time is 0.7μ sec.

A MICROELECTRONIC ANALOG-TO-DIGITAL CONVERTER AND SYNC GENERATOR
J. D. Allen, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 6 Feb. 1964, 25 p., refs., N64-18245.

. . . for use in spacecraft television. Fabrication technology is discussed, and material selection criteria are presented. It is concluded that the combination of semiconductor and thin-film techniques discussed offers considerable advantages in this and other microelectronic applications.

SOME ASPECTS OF THE LOGICAL DESIGN OF A CONTROL COMPUTER: A CASE STUDY
R. L. Alonso, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 687/697.

Some logical aspects of a digital computer for a space vehicle are described, and the evolution of its logical design is traced. . . . the Apollo Guidance Computer (AGC). . . is an onboard computer for one of the forthcoming manned space projects, a fact which is relevant primarily because it puts a high premium on economy and modularity of equipment, and results in much specialized input and output circuitry. The computer is a parallel, single address machine with more than 10,000 words of 16 bits. Such a short word length yields advantages of efficient storage and speed, but at a cost of logical complexity in connection with addressing, instruction selection, and multiple-precision arithmetic.

"BUILT-IN" RELIABILITY FOR THE SKYBOLT COMPUTER
F. A. Applegate, In: National Symposium on Reliability and Quality Control, 10th, Washington, D. C., Jan. 7-9, 1964, p. 399/414, A64-15968.

Survey of the development of the reliability program for the Skybolt Ballistic Missile Guidance Computer. . . .

DETECTION AND CORRECTION OF FAILURES IN DIGITAL ARITHMETIC UNITS
A. A. Avizienis, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 21/24.

The results of an investigation of redundancy in guidance computers (Ref. 1) led to the choice of product coding of binary numbers to implement the detection of arithmetical and transmission errors. . . .

REDUNDANCY TECHNIQUES FOR RELIABLE FLIGHT-CONTROL COMPUTERS
J. J. Fleck, IEEE Trans. Commun. Electronics, no. 68, Sept. 1963, p. 535/546, 46 refs.

. . . Implementation of a model flight-control computer, built for the Air Force, is explained. Judicious computer organization enhances reliability of the basic non-redundant layout, achieving a mean life-time of 1,500 hours (failure probability of 0.005 for an 8-hour mission). For an 8-hour mission, the redundant computer has an equivalent lifetime of 110 years (failure probability of 10^{-5}).

MECHANICAL DESIGN OF A FUNCTIONAL ELECTRONIC BLOCK DIGITAL PROGRAMMER FOR MISSILE AND SPACEBORNE APPLICATIONS
R. C. Frank, IEEE Internat. Conv. Rec., Pt. 6, vol. 11, March 1963, p. 202/209.

ENVIRONMENT STABILIZATION OF DATA PROCESSORS PROGRAM
R. E. Freeman, Hughes Aircraft Co., Fullerton, Calif., Quarterly rept. no. 1, 1 June-31 Aug. 1963, Rept. no. FR63 10 266, 12 Sept. 1963, AD 423 946.

. . . environment extremes. . . are defined and circuit environments anticipated with minimum and with maximum environment control are delineated. . . An ideal environment control system specification for data processors is defined.

SPACE ROLE SEEN FOR NEW COMPUTER
M. Getler, Missiles and Rockets, vol. 12, May 27, 1963, p. 31/35/36, A63-18734.

Brief discussion of the D210, a new lightweight low-power digital computer employing magnetic core-rope techniques to solve complex logic functions. . . .

A DIGITAL DECODER WITH ELECTRONICALLY CHANGEABLE CODES
J. E. Goodwin, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 73/81.

. . . a digital command decoder has been developed that can handle a large number of commands with a minimum of complexity. . . . immunity to interference, such as noise and radar pulses . . . no hardware changes are required to change the codes to which the decoder will respond. . . . said to be electronically loadable.

FIRST GEMINI COMPUTER MODEL COMPLETED
R. D. Hibben, Aviation Week and Space Technology, vol. 79, 15 July 1963, p. 58/59+, A63-19651.

. . . proposed operation of the computer during the mission. . . regarding steering, velocity changes, and radar lock-on. . . . prototype. . .

ANALYSIS OF NONCATASTROPHIC FAILURES IN DIGITAL GUIDANCE SYSTEMS
A. Holick, IEEE Trans. Electronic Comp., vol. EC-12, no. 4, Aug. 1963, p. 365/371.

A method is presented for weighting noncatastrophic failures in digital guidance systems in accordance with their effect on system accuracy. The method is discussed for one particular class of malfunctions, the transient, and the velocity and thrust termination errors of an inertially guided rocket are derived from several statistical models for transient failures assuming Poisson arrival and random duration of the failures.

TELEMETERING BUFFER STORAGE FOR SPACE VEHICLES
R. D. Kodis, Data Systems Engineering, vol. 18, Oct. 1963, p. 10/14, A64-11596.

Presentation of a sequential-access coincident-current 30,096-bit core memory with self-addressing and counting circuitry, designed to store data for telemetering in rocket and space-vehicle applications. . . . Data input and output are asynchronous, one bit at a time, at any rate up to 20,000 bits per second. The unit will operate in either the read/restore or the clear/write mode.

AIRBORNE FERRET COMPUTER STUDIES
C. Krause, et al., Litton Systems, Inc., Canoga Park, Calif. Special rept., June-July 1963, Rept. no. CDC52950, 15 July 1963, 171 p., AD 422 197.

Circuit descriptions and card test procedures; Test procedure for core memory unit. . . Proposed ferret-magnetic drum memory system; Proposed Computer Configuration. . .

NUCLEAR RADIATION RESISTANCE CIRCUITRY IN A MULTIPLEXER SYSTEM DEVELOPED FOR SPACE APPLICATIONS
D. Landis, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 121/126.

. . . describes a nuclear radiation resistant p.a.m. multiplexer system developed for space applications. . . describes some of the techniques used to design semiconductor circuits for reactor radiation environments. . . .

DESIGN OF AN AIRBORNE EQUIPMENT HOUSING
F. H. Lyon, IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 163/169.

DESIGN OF AN ENCODER, CONVERTER, AND DISPLAY DEVICE
S. Rubin, American Machine and Foundry Co., Alexandria, Va., Rept. for 4 Sept. 1962-30 April 1963, ASD TDR63 659, Oct. 1963, 168 p., AD 423 552.

Communication between an airborne navigational computer and the navigator requires means for encoding decimally entered information, displaying output information, and converting between the binary notation of the computer and the decimal notation of the operator. . . . Conversion between binary and B.C.D. notation is accomplished by a fixed-program, special-purpose computer coupled to the navigational computer. . . .

APPLICATION OF MULTI-APERTURE DEVICES IN SPACEBORNE DIGITAL CONTROL EQUIPMENT
W. R. Schultz, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 425/429.

. . . describe the use of magnetic core circuitry in two digital control machines that have been developed and successfully operated in flight environment by Lockheed Missiles and Space Company. . . .

HYBRID DIGITAL ANALOG PULSE-TIME TECHNIQUES FOR FLIGHT CONTROL SYSTEM COMPUTERS
W. R. Seegmiller, IEEE Trans. Commun. Electronics, no. 68, Sept. 1963, p. 498/503.

PACKAGING OF AIRBORNE MULTIPLEXER—ENCODER PCM TELEMETRY SYSTEM
B. H. Singletary, et al., Rec. Nat. Space Electronics Symp., no. 2.5, 1963.

. . . design, construction and environmental testing of the mechanical packaging. . . for use on the Titan III missile program. . . .

ASTRONAVIGATION COMPUTER RESEARCH
Sperry Gyroscope Co., Great Neck, N. Y., Final rept., Rept. no. CA4221 0089 1, ASD TDR63 337, 4 April 1961-23 May 1963, Oct. 1963, 125 p., AD 423 704.

The feasibility of a magnetic-logic computer is reported. An improvement in reliability of from four to five times that achieved in equivalent semiconductor computers has been demonstrated by a substantial decrease in the number of active components. This decrease has been made possible by the use of four-phase inhibit logic and current steering in conjunction with microprogramming techniques. . . . A biaperture ferrite element was developed for use in memories and registers in the temperature range from -55°C to +125°C. . . .

PULSED RADIATION EFFECTS ON AEROSPACE DIGITAL COMPUTERS
International Business Machines Corp., Owego, N.Y., Space Guidance Center, Kirtland AFB, N. Mex., AF Weapons Lab., First Annual Report, 21 May 1962-21 May 1963, RTD-TDR-63-3051, Oct. 1963, 221 p., refs., AD 423 083, N64-12235.

Related Publications:

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 47/50.

Stored-Program Controller.

The principal function of the arithmetic unit (A/U) of the stored-program controller (SPC) is to perform arithmetic operations on numbers. The present unit can add, subtract, compare, and store numbers. Later, the necessary controls will be added to provide for shifting, multiplication, and division. . . . Another closely-related family of operations are the bit-wise or logical operations which operate on individual bits of a word independently of operations performed on other bits. The third function of the A/U is to provide information to assist the control unit (CU) in directing the flow of the program.

SILICON SEMICONDUCTOR NETWORKS MANUFACTURING METHODS
J. W. Lathrop, et al., Texas Instruments, Inc., Dallas. Interim tech. engineering rept., Oct.-Dec. 1961, Aug. 1962, 47 p., incl. illus., tables, AD 283 979.

. . . A molecular electronic computer incorporating 587 semiconductor networks has been delivered and demonstrated to the Air Force.

DATA TRANSMISSION AND TRAJECTORY DETERMINING DEVICES FOR RESEARCH ROCKETS AND SATELLITES
J. Spencer Rochefort, et al., Electronics Research Lab., Northeastern U., Boston, Mass., Final rept., vol. 1, April 1958-30 June 1963, AFCRL 63 821, vol. 1, 30 June 1963, 75 p., AD 416 023.

. . . majority of the report deals with the unpublished work: . . . dual triggered parallel-read commutator for an aspect system. . . effects the plasma sheath on communications . . . instrumentation of the Research Satellite for environmental Sciences. . .

Section 3A.83

3A.830: Aircraft Flight Computers

Included: Thin film aircraft computer; Airborne computers; Airborne navigation computers.

Cross References: Space guidance computers (3A.840); Space science data processors (3A.850).

Principal Publications:

TRANSAC C-1100: TRANSISTORIZED COMPUTERS FOR AIRBORNE AND MOBILE SYSTEMS
G. L. Hollander, IRE Trans. Aeron. Navig. Electronics, vol. ANE-5, Sept. 1958, p. 159/169.

The Transac C-1100 digital control computers designed to handle in a single computer such functions as aircraft stabilization, navigation, cruise control, and landing are discussed.

THE RELATIVE MERITS OF INCREMENTAL AND CONVENTIONAL DIGITAL COMPUTERS IN AIR-BORNE REAL-TIME CONTROL
S. M. Shackell, et al., Commun. and Electronics, vol. 79, no. 50, Sept. 1960, p. 393/400.

A FILM ELECTRONICS AIRBORNE COMPUTER
W. N. Carroll, In Office of Naval Research, Wash., D. C., Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D. C., Sept. 24-26, 1962 (1963), p. 141/160, N63-17363.

HCM-202 THIN FILM COMPUTER
M. M. Dalton, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 536/541.

. . . the latest in a family of high performance parallel computers for aerospace application. . . advanced thin film construction. . . unique and highly flexible interconnection technique which has solved one of the major stumbling blocks to effective thin film construction of complex digital computers.

AN EXPERIMENTAL AIRBORNE COMPUTER
W. R. Payne, J. Inst. Navig., vol. 16, April 1963, p. 216/219, A63-17945.

. . . system employing the General Electric Digital Experimental Airborne Navigator (DEXAN) to solve certain problems of air navigation. . . .

ALTITUDE COMPUTER SYSTEM. ARINC CHARACTERISTIC NO. 549
Airlines Communications Administrative Council. Airlines Electronic Engineering Committee, Washington D. C., Aeronautical Radio, Inc., Mar. 1, 1962, 85 p., 27 refs., N63-17700.

. . . for use by commercial airlines. . . make appropriate computations of pressure altitude which will be useable externally in two forms: (1) a digitized output in 100-ft increments for feeding an ATC transponder or a combination of an altitude encoder used with an ATC transponder; and/or (2) pressure altitude information to a pilot's display or to other accessories by means of a two-speed synchro output suitable for driving an altimeter repeater indicator. . . .

A SPHERICAL TRIANGLE COMPUTER FOR MARINE AND AIR NAVIGATION
D. M. Makow, IEEE Trans. Aerospace Navig. Electronics, vol. ANE-10, no. 4, Dec. 1963, p. 324/328.

A simple analog computer, which solves the oblique and the right spherical triangle equation. . . based on the law of cosines. . . .

MINAC-5, A NEW AIRBORNE NAVIGATION COMPUTER AND CONTROL INDICATOR
M. P. Nigro, Data Systems Engineering, vol. 18, Sept. 1963, p. 45/46, 48/51, A64-10515.

. . . uses both analog and digital concepts to supply the pilot with information on position, wind speed and direction, distance to destination, bearing and ground track relative to true heading, ground track and ground speed. It can store two target destinations without loss of primary data. MINAC-5 is designed for operation in high performance aircraft with a Doppler radar system such as GPL's AN/APN-153. . . .

THE AIRBORNE DIGITAL COMPUTER IN CIVIL AIRCRAFT
W. R. Payne, et al., In: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, Collected preprints., A64-12860.

. . . Digital techniques may be employed at system or subsystem level . . .

A MAGNETIC LOGIC AIRBORNE COMPUTER
C. E. Tate, et al., In: Electronics Research and Development for Civil Aviation, Conference, London, England, Oct. 2-4, 1963, Collected preprints, A64-12866.

. . . magnetic logic, in which all the logical elements in the system are simply pieces of ferrite, which are pierced by several holes and threaded with wire. These elements are appropriately named multi-aperture devices, or MAD's. They are also commonly referred to as "transfluxors." . . .

Related Publications:

EXPERIMENTS ON THE RELATION OF THE OPERATOR TO THE CONTROL LOOP OF AN AIRBORNE DIGITAL COMPUTER
C. A. Bennett, IBM J. Res. Developm., vol. 3, July 1959, p. 275/281.

Laboratory experiments performed over a period of three years to provide design information for digital computer systems for error correction in aircraft navigation are discussed.

THE CORDIC TRIGONOMETRIC COMPUTING TECHNIQUE
J. E. Volder, IRE Trans. Electronic. Comp., vol. EC-8, no. 3, Sept. 1959, p. 330/334.

The COordinate Rotation DIgital Computer (CORDIC) is a special-purpose digital computer for real-time airborne computation. . . . a unique computing technique is employed which is especially suitable for solving the trigonometric relationships involved in plane coordinate rotation and conversion from rectangular to polar coordinates.

SELF-TESTING AND VERIFICATION TECHNIQUES AS APPLIED TO AN AIRBORNE MILITARY GUIDANCE COMPUTER
W. R. Pfeil, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 3, July 1962, p. 268/275.

. . . examines the testing requirements at each level of test. A hypothetical guidance digital computer is used as an example. . .

ALTITUDE ENCODER, ARING CHARACTERISTIC NO. 548
Airlines Communications Administrative Council. Airlines Electronic Engineering Committee, Washington, D. C., March 1, 1962, 19 p., 26 refs., N63-17749.

. . . designed for operation with an ARINC model 532C ATC transponder. . . . accepts a digitized altitude encoded signal input and converts this into a pulse train suitable for triggering the transponder whenever it is interrogated on model C. . . .

SOLID STATE TACAN RECEIVER/CODER.
N. R. Ascione, et al., ITT Federal Labs., Nutley, N. J., Bedford, Mass. Electronics Systems Div., ESD-TDR-63-128, March 1963, 52 p., 5 refs., N63-18090.

. . . for use as part of a solid-state TACAN transponder. . .

DIFFERENTIAL BALLISTIC WIND COMPUTER
A. Dornfest, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 58/71.

Section 3A.84

3A.840: Space Guidance and Control Computers

Included: Inertial navigation signal processors; Guidance computers; Space craft control computers; Flight data vehicle computer; Flight control computer.

Not Included: Navigational computation; Guidance theory.

Cross References: Ground based processors for navigation (3A.740); Navigational input subsystems (3A.343).

Principal Publications:

GUIDANCE COMPUTERS
JPL Res. Summ., vol 1, no. 36-3, April/May 1960, p. 75/76.

. . . digital computation is necessary. This is particularly true for those extended missions proposed for future interplanetary exploration. . . . effort to compute development . . .

INERTIAL NAVIGATION (In Russian)
I. A Gorenshteyn, I. A. Shul'man and A. S. Safaryan, Sovetskoye Radio, Moscow, 1962, 248 p.

. . . theoretical bases of inertial navigation, considers the basic methods of inertial-navigation system design, methods of correcting these systems and operation problems . . . a survey of the basic components of inertial systems . . .

THE APOLLO GUIDANCE COMPUTER
R. L. Alonso, et al., Rec. Nat. Space Electronics Symp., no. 6.1, 1963, N64-16174.

. . . The Apollo Guidance Computer . . . (AGC), is an airborne digital computer designed to control, test, and operate a guidance system and to determine and execute changes in spacecraft velocity for optimum performance in a lunar mission. . . . is organized as a binary, fifteen digit (bit) "general purpose" computer employing parallel word transfer and single address instructions. . . .

FLIGHT DATA SYSTEM TYPICAL SYSTEM COMPUTATIONS
C. S. Bridge, et al., Litton Systems, Inc., Woodland Hills, Calif., Rept. no. SMFD2 4, Oct. 1963, 26 p., AD 429 036.

. . . The report discusses the development of inertial and control equations for the Advanced Flight Data System in the following sections: (1) Alignment Phase, (2) Inertial Equations, (3) Correction of Input and Output Data, (4) Necessary Coordinate Transformations, (5) Thrust Cut-Off Calculations, (6) Orbital Calculations, (7) Reentry Calculations . . .

FLIGHT CONTROL COMPUTER FOR SATURN SPACE VEHICLES
J. M. Caudle, et al., Rec. Nat. Space Electronics Symp., no. 5.2, 1963, N64-16170.

. . . receives attitude signals from the stable platform, rate signals from rate gyros or lead networks, and angle-of-attack information from body-fixed acceleromenters or other sensors . . . The resultant amplified outputs drive servo actuators which gimbal the engines to provide thrust vector control for the S-I and S-IV stages. Feedback signals from the actuators close the servo loop. Provisions are made to program or switch gains in any channel for the varying needs of the flight program as it progresses. . . .

FLIGHT DATA SYSTEM ORBITAL ERROR ANALYSIS
L. Cohen, et al., Litton Systems, Inc., Woodland Hills, Calif., Engineering rept., Rept. no. SMFD2 1, Oct. 1963, 78 p., AD 429 033.

. . . consists of three system study reports on the Flight Data System; Inertial Computation Requirements, First Order Orbital Error Analysis, and Analysis of Second Order Gravitational Effects. . . . iteration rates and word lengths required of the central digital computer. . . .

THE LITTON FLIGHT DATA COMPUTER AS A RE-ENTRY CONTROL DIRECTOR
D. O. Dommasch, et al., Litton Systems Inc., Woodland Hills, Calif., Suppl. to final rept., Rept. no. SMFD2 6, Nov. 1963, 136 p., AD 429 157.

. . . utilization of the DOLIAC logic and associated systems for programming the Litton flight data computer (FDC) to provide for safe re-entry and landing of advanced flight vehicles. . . .

A NEW GENERATION SPACEBORNE GUIDANCE SENSOR STELATRAC
J. E. Holland, AIAA Guidance and Control Conference, Cambridge, Mass., Aug. 12-14, 1963, Paper 63-349, 13 p., A63-20670.

. . .STELATRAC (Space Technology Laboratories Tracking and Command), a modular all solid-state X-band guidance sensor. The requirements for rendezvous and docking, and lunar landing sensors, are briefly summarized.

STUDY AND ANALYSIS OF ADVANCED SPACEBORNE DETECTION, TRACKING, AND NAVIGATION SYSTEM PART II-ANALYTICAL SOLUTION
Westinghouse Electric Corp., Baltimore, Md., Air Arm Div., Final Report, April 1963, 454 p., refs., N64-13013.

Sensor and guidance control methods are selected; sensor measurement accuracies are specified after, and on the basis of, a study and evaluation of the resulting system performance. As a part of the analysis, control and data processing methods and mathematical techniques are considered, selected and evaluated, and digital programs employed are presented and discussed.

GEMINI PROJECT PROGRAM PLAN FOR THE LAUNCH VEHICLE GUIDANCE COMPUTER
Burroughs Corp., Detroit, Mich., 23 Aug. 1962, rev. 17 May 1963, 24 p., AD 431 251.

. . . list of deliverable items . . . appropriate test and procedure . . . milestone charts . . .

Related Publications:

SAMPLING AND QUANTIZATION ERRORS IN A DIGITALLY MECHANIZED INERTIAL NAVIGATOR
N. A. Boehmer, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 1, Jan. 1963, p. 56/61.

. . . Time and frequency domain analysis of the sampled-data system is presented and the effects of quantization present at the digital computer input and output are evaluated. . . .

EFFECT OF ACCURACY LIMITATIONS IN THE AIRBORNE DIGITAL COMPUTER ON THE CONVERGENCE OF A STAGE WISE MIDCOURSE TRAJECTORY DETERMINATION PROCEDURE
A. Holick, Hughes Aircraft Co., Culver City, Calif., 13 June 1963, 44 p., AD 408 673.

. . . effect of round-off errors on the estimation of position and velocity in midcourse navigation . . . analysis is based on Kalman's approach to linear filtering and prediction. . . .

GYROSCOPIC REFERENCES AND AIRBORNE DIGITAL COMPUTERS
R. W. Howard, In: International Federation of Air Line Pilots Associations (IFALPA), Symposium on Supersonic Transport, London, England, Nov. 12-14, 1963, Rept. London, IFALPA, 1964, vol. 2, p. 261/265, Discussion, p. 281/283, A64-16447.

. . . practical considerations in designing gyroscopic references and employing navigation computers . . . It is concluded that many of the references and computing requirements of supersonic transports can be met by equipment at present available . . .

COMPOUND AIR NAVIGATION SYSTEMS I - AN ELEMENTARY COMPOUND SYSTEM C. Powell. II - THE USE OF AN AIRBORNE DIGITAL COMPUTER IN A COMPOUND NAVIGATION SYSTEM
M. G. Pearson, J. Inst. Navig., vol. 16, Oct. 1963, p. 467/475, A64-11649.

Description of the combination of the information from a ground-based radio navigation aid (the Decca Navigator) with self-contained sources of dead-reckoning such as air data and Doppler. Examples are presented which show that the compound system formed is superior to either when used alone. . . .

Section 3A.85

3A.850: Spaceborne Information Processors

Included: Space science data processors; Command decoding processors; Science data automation system; Data handling equipment in space craft.

Not Included: Sensor systems; Description of processors for special missions.

Cross References: Scientific sensor subsystems (3A.345); Telemetry ground processors (3A.760).

Principal Publications:

A DATA CONDITIONING SYSTEM FOR THE MARINER SPACECRAFT
R. C. Baron, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 7.2, Oct. 1962.

. . . to gather information from scientific instruments aboard the spacecraft, to prepare this data for transmission to Earth, and to generate special instrumentation control and calibration signals. The . . . Scientific Data Conditioning System (SDCS) is a high density, low power, solid-state, electronic system. . . .

DATA HANDLING EQUIPMENT (OAO) REDUNDANT DESIGN ITS TRADE-OFFS AND PERFORMANCE ANALYSIS
K. L. Hall, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 7.3, Oct. 1962.

. . . There are two types of data handling equipment in the Observatories: The Spacecraft Data Handling Equipment (SDHE), and the Experimenters' Data Handling Equipment (EDHE). The SDHE is synchronized to the gimbal command information of the spacecraft and monitors the performance of other variable parameters. The EDHE is an asynchronous monitoring system that has the versatility to accommodate the many different experiments planned for later generation satellites. . . .

DATA PROCESSING FOR THE GODDARD EXPERIMENT
D. S. Kushner, Rec. Nat. Symp. Space Electronics Telemetry, no. 4.4, Oct. 1962.

. . . designed to measure the ultraviolet radiation from stars over a range of spectral wavelengths. The Data Processing Subsystem of the experiment accumulates and processes the experimental data and controls the performance of the experiment. Six parallel data channels accumulate pulses that represent the intensity of radiation at six different incremental portions of the ultraviolet spectrum. . . . sequentially sampling . . . automatically . . . Data accumulated . . . stored in spacecraft memory. Compression techniques are employed to reduce the number of bits that must be stored. . . .

THE SYNCOM I COMMAND DECODER
D. C. Mead, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 7.4, Oct. 1962.

. . . processes and executes commands sent to the satellite from the earth. . . . is a rugged, reliable, all silicon system, which uses only one transistor type, one diode type, and requires only one power supply input. Redundancy is used for critical circuits to improve subsystem reliability. The decoder is automatically turned off during non-usage in order to minimize power dissipation. . . .

LUNAR SPACECRAFT DATA HANDLING
H. M. Reynolds, et al., Proc. Nat. Telem. Conf., no. 7-1, May 1962.

. . . The conceptual design of a proposed spacecraft signal processing and data handling system is presented. objectives . . . a. To provide data processing to monitor selected scientific instruments on the surface of the moon. b. To obtain engineering data on the performance of the spacecraft . . . c. To telemeter the scientific and engineering data back to earth. . . .

DIGITAL COMPUTER APPLICATIONS OF BOSS GENERAL CATAGLOGUE OF STARS
P. S. Washington, NASA, Technical Report No. 5, July 27, 1962, 24 p., N63-18292.

A television camera with an 8.3° X 8.3° field of view in the OAO (Orbiting astronomical Observatory) is planned. To help determine the star field that might be presented to a ground observer of the TV screen, the Boss General Catalogue of 33,342 stars has been written on magnetic tape . . .

TECHNIQUES FOR NARROW-BAND TELEMETRY OF NONRECURRENT DATA
J. E. Abel, et al., Proc. Nat. Telem. Conf., no. 9-5, May 1963, 23 refs.

. . . pretransmission data processing technique . . . permits telemetering a sequence of nonrecurrent wave forms or pulses over a standard FM-FM radio telemetry system under unusual environmental conditions which preclude radio frequency propagation at the time of data occurrence. . . .

ELECTRONICS IN NUCLEAR MEASUREMENTS (In French)
D. Boclet, et al., Onde Electr., vol. 43, no. 432, March 1963, p. 311/316.

. . . problem of analysis amplitude in the instance of rapidly occuring events with statistical distribution . . . Two principal methods are explained, one analogue and the other digital. . . . sketch the more complicated problem set by a satellite.

TRACKING, TELEMETRY AND COMMAND STUDIES OF GROUND AND SATELLITE SUBSYSTEMS VOLUME I: SUMMARY
F. Geradi, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR269 4110 01 13, vol. 1, SSD TDR 63 334, vol. 1, Dec. 1963, 13 p., AD 429 305.

Some conclusions are that the integration of command and telemetry with tracking provides a fundamental and substantial benefit in equipment costs, both at the ground sites and in the vehicle. The integration does compromise the performance of communications and tracking to some extent; however, the benefits derived from the use of a single antenna, receiver and transmitter on the ground and in space to accomplish all of these tasks will represent a simplification and significant economies over the conventional tracking arrangement, which involves a multiplicity of equipments. . . .

THE ORBITING GEOPHYSICAL OBSERVATORY COMMUNICATION AND DATA HANDLING SYSTEMS
P. F. Glaser, Proc. Nat. Telem. Conf., vol. 2, no. 3-3, May 1963.

PRIMARY PROCESSOR AND DATA STORAGE EQUIPMENT FOR THE ORBITING ASTRONOMICAL OBSERVATORY
T. B. Lewis, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 677/687.

. . . a low-power, long-life, high-density command and memory system has been designed and is currently undergoing qualification testing. The digital command storage and processing element will permit reprogramming of spacecraft orientation and astronomical experiments on each orbit, even when the satellite is not in contact with the ground, while the core memory element will permit storage of experiment data for subsequent transmission to the ground. . . . the functional design of the satellite command and memory system is discussed in detail. In addition, the power conservation methods, reliability design techniques and environmental performance considerations which influenced the design of this equipment are reviewed.

PROGRAMMER ELECTRONICS. ATMOSPHERIC STRUCTURE SATELLITE EXPLORER XVII(S-6)
J. N. Libby, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., Aug. 1963, 70 p., N64-10095.

. . . Instrumentation . . . command programmer system . . . circuit descriptions . . . includes program sequence, the experimental selector switch, calibrators, and squib circuitry . . . mass spectrometer calibrators, calibrator electronics and sequencer electronics.

REMOTE PROGRAMING PROBLEMS FOR SCIENTIFIC EXPERIMENTS ON THE MOON
C. C. Mercier, In: Advances in the Astronautical Sciences, vol. VIII, New York, Plenum Press, Inc., 1963, p. 549/563, A63-17661.

. . . Desirable experiments are defined . . . Considerations of spacecraft payload capability, manipulation requirements, electrical power characteristics, telemetry capacity, duty cycles, and operational constraints, such as ground station availability, viewing restrictions, and lunar lighting conditions, result in the selection of two spaceborne programmers, one for transit operations and one unit and a number of subprogrammers for those experiments requiring a complex or repetitious sequence. Redundancy is provided by a ground-based command system capable of transmitting both manual and complex taped signal.

A PROTOTYPE SELECTIVE MONITORING SYSTEM FOR PHYSIOLOGICAL DATA
G. W. Morton, et al., Rec. Nat. Space Electronics Symp., no. 8.2, 1963.

. . . selective monitoring techniques to extract the significant information from data typical of that originating in a manned space vehicle. Use of these techniques substantially reduces the load on all portions of the transmission and analysis facilities. . . .

A TRANSISTORIZED DIGITAL COMPUTER WITH BOTH REAL AND STORED TIME ANALOG READOUT OF INFORMATION - FOR USE IN DEEP SPACE INVESTIGATIONS OF MICROMETEOR PHENOMENA
D. C. Mueler, Oklahoma State Univ. Research Foundation, Stillwater, Final rept., Dec. 1963, 96 p., AD 435 692.

. . . Report on Design, Development and Construction of Micrometeorite Detection Systems. . . . A system was designed and developed, and 24 units produced. . . . design features . . . include logic, powering, environment and packaging peculiar to this application . . .

PRACTICAL ASPECTS OF DATA PROCESSING AND ENCODING FOR SPACE COMMUNICATIONS
G. E. Mueller, Space Technology Labs., Inc., Redondo Beach, Calif., 1963, 26 p., refs, N64-12026.

. . . characteristics of the spacecraft communication links are given for Mariner, Relay, Syncom, TIROS, Ranger 6-9, OAO (Orbiting Astronomical Observatory), OGO (Orbiting Geophysical Observatory), and Surveyor. The four factors considered in the process of translating measurements and events into a form suitable for telemetry transmission are filtering, encoding, the choice of format for the code, and the capability for decoding.

BALLOON FLIGHT OF JULY 14, 1962
D. G. Murcray, et al., Denver Research Inst., Colo., 5 April 1963, 261 p., AD 403 332.

. . . made with an automatic programmed radiometer system. . . . launched from Ft. Wainwright, Alaska, July 14, 1962. . . . measurements of the infrared background radiation in various wavelengths intervals between 1.8 to 5.0 microns.

THE MARINER 2 DATA PROCESSING SYSTEM
D. B. Sparks, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 1963, 13 p., AD 407 761.

. . . introductory background information is given describing the data processing facilities and equipment, the spacecraft data commutation scheme and modes of operation, and tracking and telemetry data transmission formats . . . computer programs, and procedures used in the processing of tracking and telemetry data are presented with accompanying data flow charts . . .

INSERTION OF WIDE BANDWIDTH VIDEO DATA FOR COMMUNICATION FROM RECONNAISSANCE SATELLITES
General Electric Co., Utica, N. Y., Final rept., Sept 1962 - June 1963, ASD TDR 63 815, 20 Sept. 1963, 81 p., AD 421 526.

. . . design and . . . breadboard implementation of a wide band, high resolution data conversion system for reconnaissance satellites applications. . . . capability of 6 bit quantization of video signals with frequency components up to 25 MC. . . . the system includes parallel to series and series to parallel converters and a digital to analog converter to afford simulation of a complete communications link.

MARINER C - SCIENCE DATA AUTOMATION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 77/87.

The DAS is divided into two electrically and physically separable units; the real-time (RT) DAS and the non-real-time (NRT) DAS. The complete subsystem weighs approximately 10 lb and consumes about 4 w of spacecraft power in Mode 2 and about 9 w in Mode 3. A block diagram of the DAS is shown in Fig. 14.

Related Publications:

LOW-LEVEL HIGH-SPEED DATA SCANNING SYSTEMS
R. D. Brooker, et al., J. Brit. Instn. Radio Engrs., vol. 24, no. 4, Oct. 1962, p. 277/286, 15 refs.

A high speed data handling system for a hypersonic wind tunnel is described. The system is made up of transistorized modular elements allowing system flexibility and the possibility of further extension to cover increased scanning requirements. The low level inputs to the system are commutated by dry reed relays having characteristics which yield a fast reliable scanning switch. . . .

ADAPTIVE TELEMETRY FORMAT GENERATOR
R. E. Gottfried, et al., Proc. Nat. Telem. Conf., vol. 2, no. 10-1, May 1962.

. . . The great utility of time multiplexed formats for use in telemetry, communications, and data processing has been well established over the years. . . . The majority of telemetry formats . . . are fixed according to some prearranged sampling plan. . . . This practice has often resulted in great transmission inefficiency . . . excessive sampling results in redundance. . . . This paper describes a format generation technique which is believed to have great simplicity in terms of implementation and operational usage. The device which results can be controlled by command or self-adaptive means. . . .

SIGNAL DATA CONVERTER DESIGN SPECIFICATIONS
G. B. Kuenster, Boeing Co., Seattle, Wash., Document no. D2 80269, 6 Sept. 1962, rev., 23 Dec. 1963, 30 p., AD 430 468.

. . . for use in the X-20 spacecraft. . . . accepts data inputs from the inertial guidance system verdan computer and converts these data into forms suitable for use by the test data subsystem and certain of the pilots displays.

PROJECT RELAY DIGITAL COMMAND SYSTEM
S. H. Roth, et al., IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 2, June 1962, p. 100/103.

. . . (NASA) has developed a coded message sequence consisting of discrete, pulse-duration-modulated (PDM) tone bursts for commanding satellites. The message consists of a sync pulse followed by some combination of six pulses, three each of zeros and ones. This code allows for 20 commands (the combination of six things taken three at a time). . . . equipment developed for the Relay satellite program which demodulates the tone bursts, converts the pulse-duration modulation into a binary code, and then decodes the message into twenty discrete commands. . . . The subcarrier tone amplitude-modulates a VHF carrier for transmission to the vehicle. . . .

DATA HANDLING AND PROCESSING FOR CONTROL
B. B. Boone, Integrated Range Mission, White Sands Missile Range, N. Mex., 1963, 11 p., AD 406 666.

Missile range telemetry and tracking instrumentation . . . Automatic signals derived from instrumentation data are used for control functions such as booster ignition and attitude adjustment . . .

INVESTIGATION OF SPACE PROBE DATA CONDITIONING AND REDUCTION METHODS
D. B. Brzezenski, et al., Wolf Research and Development Corp., West Concord, Mass., AFCRL-63-842, June 20, 1963, 68 p., N63-20913.

. . . The digitizing equipment is described. The magnetic tape formats used by FORTRAN are described . . . the program flow charts are illustrated with descriptions of the program logic . . .

TELEMETRY DATA PROCESSING FOR THE ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORY SATELLITE
R. Coates, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md, Oct. 1963, 21 p., refs., N64-11812.

APT USERS'GUIDE
L. Goldshlak, Allied Research Associates, Inc., Concord, Mass., ARA T9219 1, AFCRL 63 655, June 1963, 43 p., AD 409 109.

A guide to data handling techniques for the Nimbus Automatic Picture Taking (APT) subsystem . . . originally intended to be flown aboard the Nimbus satellite, an experimental TIROS APT sub-system may preceed the Nimbus flight . . .

THE DEVELOPMENT OF AIRBORNE SPECTRUM ANALYZERS FOR TELEMETRY BANDWIDTH COMPRESSION
A. G. Ratz, et al., Proc. Nat. Telem. Conf., no. 9-1, May 1963.

AN AIRBORNE VIBRATION ANALYSIS SYSTEM
C. L. Schuster, Proc. Nat. Telem. Conf., no. 9-2, May 1963.

. . . The band-pass filter and peak storage system described here is one method of analyzing vibration data prior to its transmission. . . .

VOLUME 3 - PART B

ADVANCED TECHNIQUES

There are many results of recent research and development activities which show great promise for application in space communications. Millimeter and infra-millimeter wave technologies will permit the application of antennas with very high gain, yet of manageable size. They are discussed in division 3B.2.

Optical techniques are already under consideration for many applications as may be seen from the large number of references in subdivision 3B.380. Coherent light communications systems are perhaps the most important of these applications as far as space communications is concerned. The large amount of references to the newly emerging art of optronics are presented in two divisions.

Division 3B.3 brings a selection of references to optical components and subsystems. This division is concerned with fiber optics, lasers and other electro-optical devices. It contains a fairly complete bibliography of optical modulation, demodulation and amplification devices, which are essential for any advanced optical communications systems.

Division 3B.4 deals with optical communications systems, primarily for space communications applications.

Division 3B.5 has a selection of references to potential future communications techniques. The papers quoted in this division explore many ranges of physics and many speculate about the possibilities of using novel media such as X-rays, gamma rays, corpuscular radiations or gravitational fields as the carriers of information.

Division 3B.6 presents a cross-section through the literature in bionics; because it is felt that this will be an art with many potential applications in space communications. The study of the extremely efficient communications systems of man and of animals may lead to interesting new discoveries and to important improvements in space electronics technology.

DIVISION 3B.2
ULTRA-MICROWAVE TECHNIQUES

This division deals with frequencies above 30,000 Mc (30 Gc) and with the devices for their generation, modulation, amplification, conversion and demodulation. This frequency range is known as the millimeter wave range, extending into the infra-millimeter regions, or as miniature wave band. The techniques applied in this range are in general extensions of the well-known microwave techniques.

There are three introductory sections on general references, theoretical and propagation of quasi-optical waves articles and on discussions of components. Antennas are not included.

The section 3B.23 deals with electron tube devices and with their use for the generation of miniature waves. It is followed by a section on other devices used for the same purpose. Solid state devices, to the degree that applications have been found in this extreme frequency band, are referenced in section 3B.24.

The remaining sections contain references to modulation, amplification, detection and conversion devices for this frequency band. Sections on applications and measurements conclude the division.

Section 3B.20

3B.200: Reviews of Quasi-optical Techniques

Included: Surveys of millimeter wave techniques; Submillimeter wave generators in general; Inframillimetric waves; Ultra-microwave techniques.

Not Included: Microwave techniques in general; Infrared sensors (3A).

Cross References: Infrared communications systems (3B.472); Receiver techniques above 30 gigacycles (3B.260); UV communications systems (3B.473); X-ray and gamma ray communications (Div. 3B.5).

Principal Publications:

PROCEEDINGS OF THE SYMPOSIUM ON MILLIMETER WAVES, MARCH 31, APRIL 1, 2, 1959
J. Fox (editor), New York, Interscience Publishers Inc., 1960, 656 p.

. . . sponsored by the Polytechnic Institute of Brooklyn Microwave Research Institute. . . .

ELECTRON TUBES AND DEVICES IN THE 4.3-mm FREQUENCY RANGE (70 Gc)
H. J. Hersh, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 4, Oct. 1960, p. 481/492.

SURVEY OF THE LITERATURE ON MILLIMETER AND SUBMILLIMETER WAVES
J. Lurye, Technical Research Group, New York, Scientific rept. no. 2, Rept. no. TRG-127-SR-2, 30 June 1960, AD 243 242.

This report contains a survey of the literature on millimeter and submillimeter waves with emphasis on their application to the problem of communication between two high altitude hypersonic vehicles. The topics covered are sources and amplifiers, the effect of the ionized sheath, propagation phenomena, and (briefly) detectors. The survey is followed by a comprehensive bibliography of the subject. . . .

FUTURE ASTRO-COMMUNICATION TECHNIQUES
J. E. Palmer, et al., RCA Defense Electronic Products, Camden, N. J., RADC TN 60-142, Aug. 1960, AD 243 698.

. . . investigation of . . . rf power generating techniques at microwave frequencies . . . in the fields of plasmas, traveling-wave tubes, nonlinear reactances, and Cerenkov radiation . . .

MILLIMETER WAVE RESEARCH
M. Cohn, et al., Electronic Communications, Inc., Timonium, Md., Tech. note 1, RADC TN 61-213, 31 Aug. 1961, 84 p., AD 265 753.

. . . a variety of transmission methods and associated components for possible utilization in the 1 millimeter to 0.1 millimeter wavelength region of the electromagnetic spectrum. . . .

THE POSSIBLE APPLICATIONS OF EXTREMELY HIGH FREQUENCIES TO SPACE ELECTRONICS AND TELEMETERING
J. Markin, Proc. Nat. Telem. Conf., May 1961, p. 15-48/15-66.

. . . The range above 10 kMc . . . offers smaller r-f components by virtue of a steadily decreasing wave length. These components . . . call for accuracies . . . that rapidly become impossible. The other side of the coin is the sharper antenna radiation patterns and the consequent secrecy, and protection against jamming and inadvertent interference which these shorter wavelengths afford . . .

A SURVEY OF THE PRESENT DAY POSITION ON THE GENERATION AND AMPLIFICATION OF MILLIMETER WAVES (In German)
W. E. Willshaw, Nachrichtentech. Fachber (NTF), vol. 22, 1961, p. 6/17.

. . . The survey was presented in June, 1960, and covers all the most important work up to that time. The class of generators considered includes conventional tubes, relativistic beams, plasmas, masers and solid state frequency multipliers.

NEW TRANSMITTING AND RECEIVING DEVICES FOR MILLIMETER WAVELENGTHS
H. R. Johnson, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May, 1962, p. 21/28.

THE RADIO SPECTRUM FROM 10 GC TO 300 GC IN AEROSPACE COMMUNICATIONS. VOLUME II. THE GENERATION AND HIGH LEVEL AMPLIFICATION OF MILLIMETER WAVES
I. P. Shkarofsky, et al., RCA Victor Co., Ltd. (Canada), Research rept. no. 6-400-2 (7-401-1), ASD TR 61-589, vol. 2, March 1962, p. 255, incl. illus. tables, 58 refs., AD 294 340.

.. . . state of the art . . . principles of the various conventional tubes (Klystrons, Magnetrons, forward and backward wave amplifiers and oscillators, etc.) . . . tubes which are commercially available . . . developmental types . . . high voltage electron beams using unconventional techniques . . . miscellaneous or suggested approaches to the generation of millimeter wave frequencies.

THE RADIO SPECTRUM FROM 10 Gc TO 300 Gc IN AEROSPACE COMMUNICATIONS. VOLUME I. GENERAL DESCRIPTION OF PHASE I STUDY AND PHASE II PROGRAM

F. G. Warren, et al., RCA Victor Co., Ltd. (Canada), Research rept. no. 6-400-1, ASD TR 61-589, vol. 1, Jan. 1962, p. 35, 22 refs., AD 276 274.

A survey of the state of development and of knowledge in the frequency range 10-300 Gc, with particular reference to possible uses in aerospace communications, is described. Information contained in Volumes II to VII is summarized, the subjects covered being: (1) Vol. II-millimeter waves; (2) Vol. III - Components, transmission techniques and materials; Vol. IV - Propagation and absorption; Vol. V - Plasma effects in aerospace communications; Vol. VI - System considerations: Vol. VII - Applications (Classified). The following areas are also discussed: Millimeter wave detectors, Beam transmission techniques, Interaction of antennas with plasmas in this frequency region, and Millimeter wave components using plasmas.

THE RADIO SPECTRUM FROM 10 Gc TO 300 Gc IN AEROSPACE COMMUNICATIONS. VOLUME VI. SYSTEM CONSIDERATIONS IN AEROSPACE COMMUNICATIONS

F. G. Warren, et al., RCA Victor Co., Ltd. (Canada), Final rept., Feb. 1961 - Sept. 1962 on EHF Feasibility Techniques for Aerospace Communications, Phase 1, Research rept. no. 6-400-6, ASD TR 61-589, vol. 6, Nov. 1962, 150 p., AD 400 233.

RESEARCH ON ELECTROMAGNETIC WAVE PROPAGATION EFFECTS IN DYNAMIC SITUATIONS

Electrical Engineering Research Lab., U. of Texas, Austin, Quarterly engineering rept. no. 1, 1 May-30 July 1962, July 1962, 4 p., AD 283 665.

. . . propagation of millimeter waves in the 100 to 160 kmc frequency range. . . . reflex klystron . . . superheterodyne mixing between 100 and 120 kmc. Crystal harmonic generation and detection will be used . . . between 120 and 160 kmc . . . prime interest - the attentuation and propagation characteristics around the 118.7 kmc range . . .

APPLIED RESEARCH IN MICROWAVE AND QUANTUM ELECTRONICS

J. E. Boers, et al., Electron Physics Lab., U. of Michigan, Ann Arbor, Interim scientific rept. no. 3, 5 Feb. - 5 June 1963, Rept. no. 05000 7S, 113 p., AD 416 020.

APPLIED RESEARCH IN MICROWAVE AND QUANTUM ELECTRONICS

J. E. Boers, et al., Electron Physics Lab., U. of Michigan, Ann Arbor, Rept. 05000-8-S, Interim Scientific Report No. 4, 5, June - 5 Oct. 1963, Oct. 1963, 129 p., refs., AD 423 534, N64-13892.

. . . Theoretical work is largely devoted to an investigation of low-noise phenomena and beam-plasma interactions. Experimental work is concerned with electromagnetic generation, particularly in the short wavelength regions. This includes several plasma devices, masers, and a Cerenkov radiation device . . .

MILLIMETER WAVE TECHNIQUES AND EXPERIMENTS BASED ON QUASI-OPTICAL PRINCIPLES

H. Buizert, et al., RCA Victor Co., Ltd. (Canada), Report for Feb. 1961 - Sept. 1962 on EHF Feasibility Techniques for Aerospace Communications, Research rept. no. 6-400-9, ASD TDR 63-55, Jan. 1963, 59 p., AD 400 238.

STATE OF THE ART: BACKGROUND AND RECENT DEVELOPMENTS - MILLIMETER AND SUBMILLIMETER WAVES

P. D. Coleman, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 271/288, A64-11513.

Review of the basic problems encountered in the generation, transmission, and detection of millimeter waves. Representative examples of work in these areas since 1959 are reviewed . . . One hundred and fifty-seven references dating from 1959 are listed by year and subject title.

INVESTIGATION OF NEW CONCEPTS FOR MICROWAVE POWER GENERATION

L. F. Eastman, et al., Cornell U. School of Electrical Engineering, Ithaca, Third Quarterly Progress Report, 1 Jan. - 31 March 1963, RADC-TDR-63-219, June 1963, 58 p., 2 refs., N63-19140.

A pulsed laser system utilizing a ruby crystal has been constructed to investigate the feasibility of obtaining very dense thermionic mission form a metallic cathode when it is surface heated by a pulsed laser beam. . . .

GENERATION OF SUBMILLIMETER ELECTROMAGNETIC RADIATION

E. P. Gaines, Jr., OAR Research Review, vol. 11, Nov. 18, 1963, p. 3/11, A64-12117.

Discussion of the problem of obtaining useful amounts of electromagnetic radiation in the submillimeter region, the spectrum between about 500 and 3000 gc. The areas that can be studied by means of submillimeter waves and various methods and devices proposed and tried for generating submillimeter radiation are reviewed. . . .

MILLIMETER TECHNIQUE EVALUATION OF GUIDANCE DATA ATTENUATION BY EXHAUST PLUMES
A. H. Green, Jr., Army Missile Command, Huntsville, Ala., RE-TR-63-31, 25 Sept. 1963, 36 p., refs., AD 426 419, N64-13639.

. . . The interaction of a plasma (Rocket exhaust) with an electromagnetic wave . . . An analysis . . . indicates which types of propellants render good propagation characteristics . . .

A REVIEW OF THE STATE-OF-THE-ART IN MILLIMETER TECHNOLOGY
A. H. Green, Jr., Army Missile Command, Redstone Arsenal, Huntsville, Ala., AMC RA RE TR63 30, 18 Sept. 1963, 22 p., AD 423 392, N64-12367.

. . . with regard to three primary subjects: (1) Transmission Methods, (2) Power Sources . . . (3) Signal Detection . . . conclusion that only transmission methods are at an advanced technical level, while power sources and signal detectors require further research and development.

INVESTIGATION OF MILLIMETER-WAVE MODULATION AND SIGNAL PROCESSING TECHNIQUES
L. A. Hoffman, et al., Aerospace Corp. El Segundo, Calif., Labs. Div., Semiannual Technical Report 1 Jan. - 30 June 1963, 31 Oct. 1963, 29 refs., AD 424 041, N64-12186.

. . . to advance the technology and determine the feasibility of millimeter wave communication systems in the region between 10 mm (30 Gc) and 1 mm (300 Gc) . . . two problem areas: low-noise reciever front ends and stable millimeter-wavelength reference sources . . .

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia Radiation Lab., New York, N.Y., First Quarterly Progress Report, Dec. 16, 1962 through March 15, 1963, March 15, 1963, 58 p., refs., N63-16399.

SUB-MILLIMETER WAVE GENERATION
L. C. Robinson, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 6, June 1963, p. 507/513, 35 refs.

. . . surveys the pattern and achievements of research into the problem of generating electromagnetic waves in the millimeter and sub-millimeter wavelength region of the spectrum. . . .

MILLIMETER WAVE WORK
W. V. Rusch, et al., JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 135/136.

The objective of the . . . project . . . is to investigate millimeter-wave components and techniques to ascertain the future applicability of this frequency range to space communication and tracking.

MILLIMETER PROGRAM
Ewen Knight Corp., East Natick, Mass., Final Report June 1, 1960 - April 30, 1963, July 1963, 78 p., 31 refs., N63-22540, AD 409 901.

. . . Major topics include the 28-foot precision parabolic antenna system, the feed positioning subsystem, and the receiver systems. An appendix lists a summary of Venus, and lunar observations.

Related Publications:

AN 8.6 mm SHORT-PULSE RADAR FOR INDOOR MODEL MEASUREMENTS
T. H. Legg, et al., Defense Research Telecommunications Establishment (Canada), DRTE1085, May 1962, 20 p., AD 428 456.

. . . The duration of the pulse is short enough (about 15 millimicroseconds) to resolve the reflections from scatterers 10 feet or more apart. Separate transmitting and receiving antennas allow forward and back scattering and the polarization of the scattered signals to be studied. . . . The peak transmitter power is about 30 kw, the tangential sensitivity of the receiver is -52 dbm, and the dynamic range is 50 db. . . .

Section 3B.21

3B.210: Theory and Propagation of Quasi-optical Waves

Included: Atmospheric radiation exchange at oxygen line; Propagation characteristics in the vicinity of the 183 Gc/s water vapor line.

Not Included: Theory of electromagnetic wave propagation.

Cross References: Propagation of optical frequencies (3B.410); Propagation of IR radiation (3B.472); Propagation of UV radiation (3B.473).

Principal Publications:

PROPAGATION MEASUREMENT IN THE VICINITY OF THE 183 Gc/s WATER VAPOR LINE
G. T. Coats, et al., Texas U. Electrical Engineering Research Lab., Austin, Rept. 7-20, Feb. 5, 1962, 20 p., 9 refs., N63-18262.

THE RADIO SPECTRUM FROM 10 Gc TO 300 Gc IN AEROSPACE COMMUNICATIONS. VOLUME IV. ABSORPTION IN PLANETARY ATMOSPHERES AND SOURCES OF NOISE
A. Evans, et al., RCA Victor Co., Ltd. (Canada), Research rept. no. 6-400-4; 7-401-2, ASD TR 61-589; vol. 4, Aug. 1962, 174 p., incl. illus., tables, 28 refs., AD 294 452.

. . . absorption of electromagnetic waves in the atmospheres of the earth and other planets and noise in the 10-300 kmc frequency range. The theory of resonant absorption in gases is considered and the various factors affecting the width of the absorption bands discussed. . . . Experimental measurements . . . rain and fog . . . atmospheres of other planets . . . Theoretical aspects of noise temperature are presented. In particular the limitation of the Rayleigh-Jeans law at these frequencies is pointed out of the validity of the concept of effective antenna temperature discussed. The various sources of noise and their relative importance are outlined.

THEORETICAL STUDY OF THE BANDWIDTH CAPABILITIES OF RADIO PROPAGATION MEDIA
B. M. Fannin, Electrical Engineering Research Lab., U. Of Texas, Austin, Rept. no. 6-49, AFCRL 62-584, 31 Aug. 1962, p. 41, incl. illus., 21 refs., AD 286 387.

The question of what limitations the atmosphere may impose on the useful bandwidth for line-of-sight propagation in the centimetric-millimetric wavelength region was investigated. . . . definition of a really suitable, unique parameter to be taken as the bandwidth of a time-varying system. . . . results nor the existing theories based on a multiple-scatter mechanism furnish an adequate base for performing bandwidth calculations.

MILLIMETER FREQUENCY CONVERSION TABLES OF WAVE-GUIDE WAVE-LENGTH AND FREE-SPACE WAVELENGTH IN THE 50-325KMC/S RANGE
V. C. Kapfer, Rome Air Development Center, Griffiss Air Force Base, N. Y., Rept. no. RADC TDR 62-80, April 1962, 112 p., incl. illus. tables, 4 refs., AD 276 357.

. . . for the various types of approved wave guides listed in military standard MS-90035 for the frequency range from 50 to 325 kmc. The tables may also be used for Navy E wave guides as covered in revision D to MS-90035.

OPTICS OF MILLIMETER WAVES AND RADIO-ASTRONOMY
A. E. Salomonovich, Joint Publications Research Service, Washington, D. C., JPRS 16686, 14 Dec. 1962, 16 p., 9 refs., AD 298 315.

RESEARCH ON MILLIMETER WAVE PROPAGATION AT HIGH ALTITUDES
Electrical Engineering Research Lab., U. of Texas, Austin, Semi-annual engineering rept., 1 March - 31 Aug. 1962, 31 Aug. 1962, 9 p., illus., AD 285 111.

. . . Summaries are given of the accomplishments and present status of research activities involving (1) laboratory microwave spectroscopy measurements of the shape and intensity of oxygen absorption lines at simulated pressure altitudes to 100,000 feet in 58-62 kmc frequency interval, (2) total atmospheric absorption measurements at various frequencies in the 64-69 kmc interval using solar radiometric techniques, and (3) instrumentation for radiometric observations between 58 and 62 kmc at an altitude of 100,000 feet using a balloon borne radiometer. (See also AD 283 951, AD 294 490).

RESEARCH ON ELECTROMAGNETIC WAVE PROPAGATION EFFECTS IN DYNAMIC SITUATIONS
Electrical Engineering Research Lab., U. of Texas, Austin, Quarterly engineering rept. no. 2, 1 Aug. - 31 Oct. 1962, 31 Oct. 1962, 3 p., AD 288 846.

. . . measurement between 100 and 160 kmc . . . to determine the interdependence of oxygen and water vapor absorption and to evaluate the propagation and emission characteristics of frequencies between 100 and 160 kmc in the earth's atmosphere. (See also AD 283 665).

STUDY OF VARIOUS RADIO PROPAGATION PROBLEMS AND OF THE PROPAGATION PARAMETERS INVOLVED THEREIN, Final Report
A. H. La Grone, Texas U., Austin, Electrical Engineering Research Lab., Rept. 6-59; AFCRL-64-54, 31 Jan. 1964, 27 p., refs., AD 435 511, N64-18634.

. . . frequency characteristics of radio propagation over a grove of trees in full leaf. . . theoretical study of the bandwidth of radio propagation media; a solution for ELF (extremely low frequency) propagation in the earth-ionosphere cavity bounded by an inhomogeneous anisotropic ionospheric medium . . .

ATMOSPHERE ABSORPTION OF ELECTROMAGNETIC RADIATION IN THE FREQUENCY REGION 120 TO 132 KMC/S. PART II.
C. O. Hemmi, Electrical Engineering Research Lab., U. of Texas, Austin, Quarterly engineering rept. no. 5, 1963, p. 40, AD 414 410.

. . . Data was taken at 5 pressures corresponding to pressure altitudes in the earth's atmosphere between 8 and 0.25 km. . . .

A SPECTROSCOPIC MEASUREMENT OF THE RESONANT ABSORPTION OF MICROWAVE ENERGY BY OXYGEN IN THE 2.5-MILLIMETER WAVELENGTH REGION
A. E. Schulze, Electrical Engineering Research Lab., U. of Texas, Austin, Quarterly engineering rept. no. 5, 1963, 72 p., AD 414 361.

. . . to measure the dependence of the oxygen component of absorption in the vicinity of 118.75 Gc. The variations of line shape, both width and intensity for a wide range of atmospheric pressures are described by the reported measurements. . . .

TE_{01}MODE COMPONENTS IN THE 3-mm REGION
A.J. Simmons, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 324/332., 11 refs., A64-11520.

FACTORS AFFECTING EARTH-SATELLITE MILLIMETER WAVE-LENGTH COMMUNICATIONS
A.W. Straiton, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 296/301, 10 refs., A64-11516.

Discussion of the possible use of millimeter wavelengths for satellite transmissions, by employing the large bandwidths and high gain with small antennas possible at these wavelengths . . . The attenuation through the entire atmosphere over the millimeter spectrum is given as a function of elevation angle of the antenna beam. . . .

ATTENUATION OF THE EARTH'S ATMOSPHERE BETWEEN THE FREQUENCIES OF 100 AND 140 Gc/s.
C. W. Tolbert, et al., Electrical Engineering Research Lab., Univ. of Texas, Austin, Quarterly engineering rept. no. 6, 1 Aug. - 31 Oct. 1963, 30 Oct. 1963, 17 p., AD 422 421.

. . . investigation of atmospheric oxygen and water vapor attenuation between the frequencies of 116 and 124 Gc/s by measurement of the attenuation of simulated atmospheres in a 500 foot long absorption cell. . . .

THE ATTENUATION AND EMISSION IN THE EARTH'S ATMOSPHERE OF THE COMPLEX OF 60 GC/S OXYGEN LINES
Electrical Engineering Research Lab., Univ. of Texas, Austin, Final rept. of research, 1 Sept. 1961 - 30 April 1964, Rept. no. 5 53, 30 April 1964, 1 v., AD 437 225.

. . . between sea level and 100 thousand feet over the frequency interval of 58 to 62 kMc/s. . . . real and simulated atmospheres. . . attenuation . . . caused primarily by 25 major oxygen lines centered at approximately 60 kMcs. . . . the values of attenuation at line center frequencies and at frequencies between the lines are 200 db and 145 db, respectively. . . .

ATTENUATION AND EMISSION OF 58 TO 62 kMc/s FREQUENCIES IN THE EARTH'S ATMOSPHERE
Electrical Engineering Research Lab., U. of Texas, Austin, Research rept., 1 Sept. 1961 - 31 March 1963, Rept. no. 5-52, 1 v., incl. illus., table, refs., AD 400 954, AD 407 421.

. . . The resulting values are in good agreement with calculated values of attenuation and are corroborated by measurements of the attenuation through the earth's atmosphere, using the sun as a signal source, between 64.6 and 68.6 kMc . . .

INTERFERENCE ANALYSIS STUDY
Jansky and Bailey Div., Atlantic Research Corp., Washington, D. C., Final rept., RADC TDR 63 379, June 1963, 410 p., AD 422 375.

. . . propagation . . . variability is discussed along with a summary of propagation factors which must be considered for frequencies above 50 kMc.

Section 3B.22

3B.220: Special Components for Millimeter Wave Range

Included: Waveguides above 30Gc/s; Millimeter wave launching devices; Power leveler; Ferrite switches; Hexagonal ferrite isolators; Duplexers; Groove guides; Grating systems as filters; Tunnel diode performance at millimeter waves; Varactor diodes at millimeter waves; Point-contact wafer diodes; Ferromagnetics at millimeter waves; Ferroelectric ceramics at millimeter waves.

Not Included: Microwave components in general.

Cross References: Optical components (3B.330); Ferromagnetic type parametric amplifier (3B.250); Diode mixers (3B.260).

Principal Publications:

QUASI-OPTICAL COMPONENTS AND SURFACE WAVEGUIDES FOR THE 100 TO 300 KMC FREQUENCY RANGE
M.J. King, et al., Electronic Communications, Inc., Timonium, Md., Scientific rept. no. 2, Nov. 1960, 113 p., incl. illus., tables, 30 refs., AD 249 822.

. . . design and construction of fundamental components . . . Experimental measurements were made at 105 and 140 kmc on these two types of surface wave-guides.

DEVELOPMENT OF BANDPASS MILLIMETER DUPLEXER
A.G. Barrett, Bomac Labs., Inc., Beverly, Mass., Final rept., 15 Feb. 1959-20 Nov. 1961, AD 271 064.

The successful development of the duplexer type BL-P-017D demonstrates the feasibility of scaling a conventional balanced duplexer design to operate at 4.3 millimeters. . . . exceeds the performance of the BL-24 branched duplexer in terms of lower losses and lower spike and flat leakage. . . . is more rugged and compact because the glass reservoir and tuning mechanism are eliminated from the package.

DESIGN OF MILIMETER WAVEGUIDE COMPONENTS
J.W.E. Greismann, Microwave Research Inst., Polytechnic Inst. of Brooklyn, N.Y., Quarterly rept. 5, July 1-31 Aug. 1961, Rept. PIBMRI-875.15, 6 Oct. 1961, 16 p., AD 267 680, AD 252 871.

FERRITE AND ANTIFERROMAGNETIC MILLIMETER AND SUBMILLIMETER DEVICES
G.S. Heller, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 82G-0025, 16 Feb. 1961, 10 p., AD 251 246.

The typical performance of one of several experimental 2-mm Y-type circulators which utilize ordinary ferrite materials is discussed. The feasibility of utilizing antiferromagnetic materials for millimeter and submillimeter devices is shown. The only limiting factor in fabricating Y-type circulators seems to be the difficulty in fabricating small components . . .

BAND-SPLITTING FILTER
E.A. Marcatili, et al., Bell Syst. Tech. J., vol. 40, no. 1, Jan. 1961, p. 197/212.

A constant-resistance filter capable of dividing a very wide band into two subbands in described. It can handle one octave in the millimeter region with only 1.5 db insertion loss for each subband. The splitting transition takes place in a very narrow band (160 mc).

THE H-GUIDE. A USEFUL WAVEGUIDE FOR MILLIMETER WAVES
J. Reindel, Electronic Defense Labs., Mountain View, Calif., Tech. memo EDL-M377, 11 Aug. 1961, 34 p., AD 265 851.

INVESTIGATION OF MICROWAVE NON-LINEAR EFFECTS UTILIZING FERROMAGNETIC MATERIALS
R.W. Roberts, et al., Melabs, Palo Alto, Calif., Quarterly progress rept. 4, 4 July-4 Oct. 1961, 4 Oct. 1961, 24 p., AD 269 572.

. . . described as a 70 gc power divider, a new device used as a variable, high-power attenuator in doubling experiments. Data resulting from 8 to 4 mm doubling is presented as a basis for extending present methods to klystron operation. The signal and idler resonances, of the ferrite amplifier are described as magnetodynamic modes. Experimental verification of this description is presented. . . . Operation of the amplifier as a lower sideband upconverter is reported.

3-MILLIMETER WAVEGUIDE COMPONENTS
A.J. Simmons, Technical Research Group, Somerville, Mass., Rept. no. 161-1, 30 Oct. 1961, 38 p., AD 268 279.

Research concerns the development of waveguide components in the 3.2 mm band . . . Items discussed are a transition, mode filter, band, 10 db coupler, flexible section, high and low-power terminations and coupling flanges. . . . The design of ferrite devices for this band, and a measurement program for ferrite rotators is discussed. Ferrite devices will be based on the Faraday rotation principle, making use of dual mode transducers to obtain isolators and circulators.

WAVEGUIDE EQUIPMENT FOR 2 MM MICROWAVES
G.W. van Es, et al., Philips Tech. Rev., vol. 22, no. 4, Feb. 1961, p. 113/125.

GENERALIZED CONFOCAL RESONATOR THEORY
G.D. Boyd, et al., Bell Syst. Tech. J., vol. 41, no. 4, July 1962, p. 1347/1370.

. . . extended to include the effect of unequal aperture size and unequal radii of curvature of the two reflectors. . . .

MILLIMETER WAVE RESEARCH
J.M. Cotton, et al., Electronic Communications, Inc., Timonium, Md., Final technical rept., RADC TDR 62-626, 16 Dec. 1962, 148 p., incl. illus., tables, AD 274 543, AD 278 656.

. . . study of propagation methods for possible use in the submillimeter wavelengths region. . . . trough waveguide, oversized waveguide and Fresnel region propagation. . . . data taking at 210, 280, 350, and 420 Gc. . . .

A ROTARY COUPLING FOR A MILLIMETER-WAVE R-F CHANNEL
E.M. Guttsayt, Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 17 July 1962, 4 p., incl. illus., Trans. no. FTD-TT-62-648 from Soviet Patent, no. 138278 (642919/40), 3 Nov. 1959, AD 286 196.

. . . an H-shaped metal-dielectric waveguide, which is excited under longitudinal-wave conditions, is used. . . .

SUBMILLIMETER WAVE COMPONENT DEVELOPMENT
H.J. Hindin, et al., Airborne Instruments Lab., Inc., Mineola, N.Y., RADC TDR 62-536, Oct. 1962, 1 v., incl. illus., 19 refs., AD 291 729.

Techniques for the design, construction, and evaluation of a 10-db directional coupler, a 9 to 40 db variable attenuator, a 90-degree phase shifter, and a duplexer to operate in the 300 to 1000 Gc region were investigated theoretically and experimentally. Quasi-optical techniques, oversize-waveguide, trough-guide, and Goubau beam guide were studied. . . .

THE RADIO SPECTRUM FROM 10 Gc TO 300 Gc IN AEROSPACE COMMUNICATIONS. VOLUME III. COMPONENTS, TRANSMISSION TECHNIQUES AND MATERIALS
H.J. Moody, et al., RCA Victor Co., Ltd. (Canada), Research rept. no. 6-400-3, ASD TR 61-589, vol. 3, July 1962, 324 p., incl. illus., tables, refs., AD 294 341.

. . . discusses transmission lines, components and properties of materials at millimeter wavelengths. . . . Low noise amplifier devices, masers, parametric amplifiers and low noise travelling wave tubes are reviewed and the limiting noise temperature at high frequencies is presented. A thorough discussion of antennas and antenna systems, i.e., scanning antennas is included.

CRYSTAL-VIDEO DETECTOR HOLDERS FOR MILLIMETER WAVEGUIDES
L. Riebman, American Electronic Labs., Inc., Colmar, Pa., Quarterly progress rept. no. 3, 1 March-30 June 1962, Rept. no. 61024-3, July 1962, 9 p., incl. tables., AD 283 400.

. . . Experimental models will be supplied in four ranges: 33-50 Gc; 50-75 Gc; 75-110 Gc; 60-90 Gc. In each range, six holders and twelve crystals will be supplied. . . .

2-MILLIMETER WAVEGUIDE COMPONENTS
A.J. Simmons, Technical Research Group, East Boston, Mass., Quarterly rept. no. 4, 1 April-30 June 1962, Rept. no. 161-4, 33 p., incl. illus., tables, AD 283 427, AD 289 127.

. . . Mode purity tests on a flexible waveguide indicate acceptable performance, with no measurable introduction of spurious modes. . . . The prototype variable attenuator was tested. . . . A 3-db sidewall hybrid was built. . . .

MILLIMETER WAVE COMPONENT RESEARCH
F. Sobel, et al., Electronic Communications, Inc., Timonium, Md., Final rept., March 1962, 67 p., incl. illus., tables, 18 refs., AD 275 576.

. . . techniques for the generation, transmission, and the detection of energy in the 100 to 300 gc frequency region . . . phase-correcting Fresnel zone plates . . . frequency stability of a klystron. . . . propagation characteristics of single-conductor transmission lines . . . dielectric image lines. . . . two types of surface waveguides . . .

MILLIMETER WAVE CAVITY COUPLING BY QUARTERWAVE TRANSFORMER
R.J. Strain, et al., Illinois U., Urbana, 20 July 1962, 3 p., AD 407 875.

The utilization of an iteration of parallel plane waveguides as a lambda/4 transformer to couple a millimeter wave cavity has been shown to be both effective and simple to design . . .

MILLIMETER WAVE COMPONENTS (HEXAGONAL FERRITE ISOLATORS)
D.R. Taft, et al., Sperry Microwave Electronics Co., Clearwater, Fla., Quarterly rept. no. 2, 15 June-15 Sept. 1962 on Development of Broadband Miniaturized Millimeter Wave Isolators Incorporating Ferrites with Hexagonal Crystal Structures, Rept. no. SJ-224-0039-2, Oct. 1962, 1 v., incl. illus., tables, 7 refs., AD 296 922, AD 284 654.

HIGHER MODES IN MILLIMETER WAVE ISOLATORS (Correspondence)
P. Vilmur, et al., Proc. IRE, vol. 50, Jan. 1962, p. 98/99.

3.0-MILLIMETER WAVELENGTH DUPLEXER
J.D. Woermbke, et al., Westinghouse Electric Corp., Baltimore, Md., Quarterly progress rept. no. 1, 15 April-15 July 1962, Rept. no. 1, 15 July 1962, 24 p., incl. illus., AD 286 993, AD 291 607.

. . . development of two gas switching devices for receiver protection over a frequency band of 91 to 96 kmc. One tube is a dual TR tube for use in a balanced duplexer and the other tube is a crystal protector. The balanced duplexer shall operate at peak power levels of at least 10 kw and a duty cycle of 0.0005 while the crystal protector shall provide receiver crystal protection from peak power levels from 51 milliwatts to 1000 watts at a 0.0005 duty cycle. Both tubes will be built in TG-99 rectangular waveguide. . . .

STATUS REPORT ON INTERNATIONAL MILLIMETER WAVEGUIDE FLANGE STANDARDS
T.N. Anderson, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 427/429, A64-11534.

SUBMILLIMETER RADIOMETRY
J.W. Battles, et al., Naval Ordnance Lab., Corona, Calif., NAVWEPS 8169, 1 Nov. 1963, 30 p., AD 424 017.

. . . a short survey is given of millimeter and submillimeter wave components . . .

MILLIMETER WAVE DIODE FABRICATION
D. Bauerle, Ballistic Research Labs., Aberdeen Proving Ground, Md., BRL TN1525, Jan. 1964, 19 p., AD 434 047.

. . . technique for fabricating diodes used in millimeter wave detectors, mixers, and multipliers.

MILLIMETER WAVE LAUNCHING DEVICES AND TECHNIQUES
L. Birenbaum, Microwave Research Inst., Polytechnic Inst. of Brooklyn, N.Y., Quarterly rept. no. 3, 15 Sept.-15 Dec. 1963, 4 Feb. 1964, 22 p., AD 434 542.

An experimental model (for 10Gc) of an Oguchi transition from rectangular to circular waveguide was redesigned by modifying the coupling hole size. . . .

LONG LIFE K-BAND DUPLEXER
R. Brunton, Microwave Associates, Inc., Burlington, Mass., Fourth Quarterly Technical Report, 1 April-1 July 1963, 7 May 1963, 51 p., refs., AD 423 267, N64-11751.

BASIC RESEARCH IN MICROWAVE DEVICES AND QUANTUM ELECTRONICS
H.K. Detweiler, et al., Electron Physics Lab., Univ. of Michigan, Ann Arbor, Quarterly progress rept. no. 1, 1 May-1Aug. 1963, Rept. no. 05772 1P, Sept. 1963, 49 p., AD 420 556.

. . . analysis of the feasibility of frequency multiplication by means of passing a fast cyclotron wave into a magnetron-type cavity is given in some detail. . . . A nonlinear analysis of simultaneous amplification of two input frequencies by a traveling-wave amplifier is given . . .

45-Gc PARAMETRIC OSCILLATIONS AND INDUCED NEGATIVE RESISTANCE USING VARACTORS (Correspondence)
G.W. Fitzsimmons, Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1796/1797.

A versatile Q-band parametric amplifier was previously reported to emit oscillations in both degenerate and nondegenerate modes (depending on tuning) about 35.5 Gc. This same amplifier using a point-contact, gallium arsenide varactor, has now been made to oscillate in similar modes about 45 Gc. The pump at 90 Gc consisted of a Raytheon QKi 73 klystron. . . .

DESIGN OF A NARROW WALL TRANSVERSE SLOTTED WAVEGUIDE ARRAY AT 70 GC
F.M. Gray, Harry Diamond Labs., Washington, D.C., HDL TR1152, 30 Sept. 1963, 31 p., AD 423 320.

. . . for a low-power lightweight, 70 Gc ground ranging radar system. Narrow-wall transverse slot arrays were designed, using both the Taylor and the uniform aperture distributions. . . .

DESIGN OF MILLIMETER WAVEGUIDE COMPONENTS
J.W.E. Griemsmann, Microwave Research Inst., Polytechnic Inst. of Brooklyn, N.Y., Final rept., 1 June 60-31 Jan. 1963, Report no. PIBMRI 1166 63, 15 May 1963, 194 p., AD 413 774.

Experimental work . . . on a variety of components built in a special type of waveguide (H-guide) for use in the 26.5-40 Gc band. . . . Extension of the work to 70 Gc is described. . . .

MILLIMETER WAVE LAUNCHING DEVICES AND TECHNIQUES
J.W.E. Griemsmann, Microwave Research Inst., Polytechnic Inst. of Brooklyn, N.Y., Quarterly rept. no. 2, 15 June-15 Dec. 1963, Rept. no. 1179 6 63, 6 Dec. 1963, 16 p., AD 428 537, AD 421 831.

. . . redesign of an Oguchi rectangular to circular waveguide transition . . . a second type of rectangular to circular waveguide transition . . . a second type of rectangular to circular waveguide transition designed by Lanciani. . . .

SUBMILLIMETER WAVE COMPONENT DEVELOPMENT
O. F. Hinckelmann, et al., Airborne Instruments Lab., Inc., Deer Park, N.Y., Quarterly rept. no. 2, Rept. no. 2098-I-2, RADC TDR 63-52, Jan. 1963, 17 p., illus., 3 refs., AD 402 327.

. . . design, construction, and evaluation of a 10-db directional coupler, a 0-40 db variable attenuator, a 90-degree phase shifter, and a duplexer to operate in the submillimeter region . . .

MICROWAVE TUNNEL-DIODE OPERATION BEYOND CUTOFF FREQUENCY (Correspondence)
C. C. Hoffins, et al., Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 370/371.

. . . A new tunnel-diode waveguide mount has been constructed which eliminates problems of excessive RF leakage encountered in the previous mount . . .

SMALL SIGNAL CHARACTERISTICS OF FERROELECTRIC CERAMICS AT MILLIMETER WAVELENGTHS
D. A. Johnson, et al., Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 332/339.

A SIMPLE GRATING SYSTEM FOR MILLIMETER AND SUBMILLIMETER WAVELENGTH SEPARATION
K. B. Mallory, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 433/434, A64-11538.

A RANGE OF 2 AND 1 MILLIMETER WAVEGUIDE COMPONENTS
R. Meredith, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 332/338, A64-11521.

ANALYSIS OF THE FREQUENCY AND POWER PERFORMANCES OF TUNNEL DIODE GENERATORS
H. J. Oguey, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 412/419, 22 refs., A64-11532.

A HIGH ISOLATION ABSORPTION MODULATOR-SWITCH FOR 1.2-CM WAVELENGTH
F. Reggia, Harry Diamond Labs., Washington, D.C., HDL TR1151, 8 July 1963, 23 p., AD 414 581.

. . . design and operation . . . of a K-band absorption modulator for high-speed switching or amplitude modulation of microwave power . . . reciprocal ferrite modulator . . .

CRYSTAL VIDEO DETECTOR HOLDERS FOR MILLIMETER WAVE GUIDES
L. Riebman, American Electronic Labs., Colmar, Pa., Final rept., 1 June 1961-28 Feb. 1963, Rept. no. 61024-4F, 28 Feb. 1963, 1 v., AD 402 357.

. . . design of crystal mounts to be used for the frequency range of 33 to 110 Gc.

MICROWAVE POWER LEVELER FOR K BAND
E. A. Rinehart, et al., Oklahoma U. Research Inst., Norman, Rept. no. TR9, 3 Sept. 1963, 2 p., AD 434 011.

A device was developed for regulating milliwatts of microwave power in the 24-kMc region. . . . was shown to operate over the electronic sweep range of a K-band reflex klystron, and to regulate power to within ±0.5%. . . .

3.0-MILLIMETER WAVELENGTH DUPLEXER
S. D. Schreyer, Westinghouse Electric Corp., Baltimore, Md., Quarterly progress rept. no. 5, 15 April-15 July 1963, 15 July 1963, 9 p., AD 419 256.

POINT-CONTACT WAFER DIODES FOR USE IN THE 90- TO 140-KILOMEGACYCLE FREQUENCY RANGE (B.S.T.J. Briefs)
W. M. Sharpless, Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2496/2499.

In millimeter wave systems, one of the most important components is the first converter or mixer . . . recently developed point-contact diode of the wafer type . . . operates efficiently as a first converter in the frequency range 90 to 140 kilo-megacycles (F-band).

THREE-MILLIMETER WAVEGUIDE COMPONENTS
A. J. Simmons, Technical Research Group, East Boston, Mass., Quarterly rept. no. 8, 1 April-30 June 1963, Rept. no. 161 8, 9 Aug. 1963, 10 p., AD 421 489, AD 408 104.

. . . design of waveguide transmission line components and/or subassemblies that may be utilized either as measurement devices or functional items of a millimeter wave system for operation over a 5% bandwidth centered at a frequency of 93.75 kmc. . . .

MILLIMETER RESONANCE ISOLATORS UTILIZING HEXAGONAL FERRITES
D. R. Taft, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 346/350, A64-11523.

DEVELOPMENT OF BROADBAND MINIATURIZED MILLIMETER WAVE ISOLATORS INCORPORATING FERRITES WITH HEXAGONAL CRYSTAL STRUCTURES
D. R. Taft, et al., Sperry Microwave Electronics Co., Clear Water, Fla., Quarterly rept. no. 5, 15 March-15 June 1963, July 1963, 32 p., AD 416 151, AD 407 662, and AD 299 076.

. . . Waveguide bandwidth operation is reported for isolators in the (18 - 26.5 Gc) - and (50 - 75 Gc) - bands.

SUBMILLIMETER WAVE COMPONENT DEVELOPMENT
J. J. Taub, et al., Airborne Instruments Lab., Inc., Deer Park, N. Y., July 1962 - March 1963, RADC TDR63 237, May 1963, 68 p., AD 410 354.

. . . 10-db directional coupler, a 0 to 40 db variable attenuator, a 90-degree phase shifter, and a duplexer to operate in the 300 to 1000 gc region . . . submillimeter components using quasi-optical techniques in oversize waveguide can be successfully designed and fabricated . . .

SUBMILLIMETER COMPONENTS USING OVERSIZE QUASI-OPTICAL WAVEGUIDE
J. J. Taub, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 338/345, A64-11522.

THE GROOVE GUIDE, A LOW LOSS WAVE-GUIDE FOR MILLIMETER WAVES
F. J. Tischer, Alabama U. Research Inst., Huntsville, RR2, Jan. 1963, 15 p., AD 402 757.

A new waveguide for the low-loss transmission of millimeter waves . . . consists of two parallel conducting walls with grooves in the central region of the guide cross-section. . . . if excited in the TE-wave mode, has similar properties as the H-guide. . . . Theoretical considerations dealing with the field distribution . . .

THE GROOVE GUIDE, A LOW-LOSS WAVEGUIDE FOR MILLIMETER WAVES
F. J. Tischer, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 291/296, A64-11515.

MILLIMETER TRANSMISSION BY OVERSIZE AND SHIELDED-BEAM WAVEGUIDES
G. R. Valenzuela, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 429/430, A64-11535.

DEVELOPMENT OF TUNABLE KU-BAND REACTANCE AMPLIFIER
J. J. Whelehan, et al., Airborne Instruments Lab., Inc., Deer Park, N. Y., Quarterly progress rept. no. 3, 1 Jan-30 March 1963, April 1963, 23 p., AD 410 469.

. . . design and development of a tunable, dual-channel, Ku-band reactance amplifier utilizing varactor diodes . . .

3.0-MILLIMETER WAVELENGTH DUPLEXER
J. D. Woermbke, et al., Westinghouse Electric Corp., Baltimore, Md., Quarterly progress rept. no. 4, 15 Jan. -15 April 1963, Rept. no. 1060D, 15 April 1963, 1v., AD 407 517, AD 299 118.

A WIDE-BAND RECTANGULAR-TO-CIRCULAR MODE TRANSDUCER FOR MILLIMETER WAVES
P. H. Wolfert, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 430/431, A64-11536.

PROPERTIES OF MINIATURIZED TUNNEL DIODE CIRCUITS AT MICROWAVE FREQUENCIES
R. W. Yancey, Naval Ordnance Lab., Corona, Calif., NAVWEPS 8144, 1 April 1963, 38 p., AD 404 095.

. . . Experiments indicate that tunnel diode operation at higher frequencies is possible . . . Tunnel diodes are very promising where low-level broadband signals are needed.

MILLIMETER GENERATION AND NONLINEAR PROPAGATION IN FERROMAGNETICS
Microwave Lab., Stanford Univ., Calif., Rept. nos. 1: ML1005, Jan. 1963, 32 p., AD 419 918.

MILLIMETER GENERATION AND NONLINEAR PROPAGATION IN FERROMAGNETICS
Microwave Lab., Stanford U., Calif., Rept. no. 4, 1 July-30 Sept. 1963, Rept. no. 1107, Nov. 1963, 19 p., AD 427 803.

MILLIMETER WAVE COMPONENTS (HEXAGONAL FERRITE ISOLATORS)
Sperry Microwave Electronics Co., Clearwater, Fla., Final rept., Rept. no. SJ224 0039 6, Oct. 1963, 1 v., AD 431 988.

. . . development of lightweight, waveguide bandwidth, ferrimagnetic resonance isolators for millimeter wave frequencies . . .

Related Publications:

CANALISATION D'ONDES ELECTROMAGNETIQUES PAR DIFFRACTION ITEREE (Canalization of Electromagnetic Waves by Repeated Diffraction) (In French, with summary in English)
G. Boivin, et al., Canad. J. Phys., vol. 41, Oct. 1963, p. 1604/1613, 13 refs., A63-24952.

Description of a beam waveguide for millimeter waves, which maintains an optimum compromise between diffraction losses and line dimensions. . . .

INVESTIGATION OF THE MICROWAVE PROPERTIES OF FERROELECTRICS
B. D. Silverman, et al., Raytheon Co. Research Div., Waltham, Mass., Final Report, Jan. 20, 1961-Jan. 19, 1963, 1963, 109 p., 73 refs., N63-16271.

. . . systematic and fundamental study. . . . The quantities singled out for investigation are nonlinear dielectric constant, microwave losses, and electrostriction. The comparison between theory and experiment is discussed.

NONLINEAR QUANTUM EFFECTS
R.G. Smith, Microwave Lab., Stanford U., Calif., April 1963, 164 p., AD 405 521.

. . . to study the . . . interaction of more than a single quantum of radiation with an atomic system . . . From the results . . . concluded that a quantum mechanical system possesses nonlinear as well as linear properties and that these nonlinear properties may find applications especially in the submillimeter and optical regions where suitable nonlinear elements do not presently exist.

OPEN RESONATORS FOR LASERS (Translation)
L.A. Vainshtein, Soviet Physics - JETP, vol. 17, Sept. 1963, p. 709/719, 17 refs., A63-22790.

Development of a theory of natural vibrations for resonators consisting of sections of circular or plane waveguide or formed by plane parallel mirrors of rectangular or circular shape. . . . Resonators of these types are of interest for lasers, and also for the physics and technology of millimeter and submillimeter waves.

Section 3B.23
Electron Tubes and Electron Beam Generators at Millimeter Waves

3B.231: Physics of Electron Beams at Millimeter Waves

Included: Stimulated emission of bremsstrahlung; Space charge waves in millimeter devices.

Not Included: Electron physics in general.

Cross References: Stimulated emission theory (3B.341); Theory of backward wave tubes (3B.238).

Principal Publications:

LIMITATIONS OF SPACE-TIME HARMONICS FOR MICROWAVE AMPLIFICATION
T.E. Everhart, et al., Electronics Research Lab., U. of Calif., Berkeley, Series no. 60, Issue no. 440, ASD TDR63 527, 14 March 1962, 52 p., AD 414 369.

The possibility of gain utilizing the interaction between an electromagnetic wave in a smooth wave guide and a space-time harmonic of the slow space-charge wave has been proposed as a method of millimeter-wave amplification. . . . conclusion that for the model considered amplification over a wide band of frequencies is not practical.

ELECTRON TUBES AND DEVICES IN THE 4.3-MM FREQUENCY RANGE
H.J. Hersh, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 4, Oct. 1960, p. 481/492.

INVESTIGATION OF HIGH FREQUENCY LIMITATIONS IN MILLIMETER WAVE GENERATORS
J. Schwinger, Schwinger, Julian, Cambridge, Mass., Final rept., May 1961, 1 v., AD 258 850.

STIMULATED EMISSION OF BREMSSTRAHLUNG
D. Marcuse, Bell Syst. Tech. J., vol. 41, no. 5, Sept. 1962, p. 1557/1572.

. . . shown in this paper that stimulated emission of Bremsstrahlung is possible if the incident electron travels more or less parallel to the electric field vector of the stimulating radiation field. The electron absorbs radiation if it travels more or less perpendicular to the electric field vector of the stimulating field. . . . amplifiers and oscillators may be constructed using this effect . . .

INVESTIGATION OF HIGH FREQUENCY LIMITATIONS IN MILLIMETER WAVE GENERATORS
J. Schwinger, Schwinger, Jullian, Cambridge, Mass., Final rept., Jan.-June 1962, June 1962, 25 p., AD 276 940.

. . . relationship between the uncertainty principle and minimum amplifier noise is examined. . . . the concept of coherence is discussed . . . Harmonic oscillator states are examined for coherence. The concept of noise is then discussed and contrasted with incoherence. . . . Spontaneous emission is examined both for coherence and noise. . . . amplifying mechanism is treated quantum-mechanically.

BUNCHING AN ELECTRON BEAM BY DEFLECTION MODULATION
J.R. Baird, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 312/317, A64-11518.

. . . A fourth-harmonic, beam-coupling experiment, at 36 Gc using a Fabry-Perot type coupler, is described. Based on these results, a proposal is presented for a beam-coupling circuit whose transverse dimensions can be made physically large compared to the free-space wavelength.

THE GENERATION OF MILLIMETER WAVES FROM CYCLOTRON EXCITATION OF TRAPPED ELECTRONS (Correspondence)
H. Dressel, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1149/1150.

. . . the Tornadotron is being investigated. . . . some recent experimental results . . .

NOTES ON THE USES OF PREBUNCHED ELECTRON BEAMS FROM LASER ILLUMINATED PHOTOCATHODES (Correspondence)
E. Frost, Proc. IEEE, vol. 51, No. 6, June 1963, p. 957/958.

. . . One can foresee difficulties in prebunching . . . as the millimeter wave region is approached. . . . A promising method of generating prebunched beams is the beating of two or more coherent light sources at a photocathode. . . .

A FURTHER DISCUSSION OF STIMULATED EMISSION OF BREMSSTRAHLUNG
D. Marcuse, Bell Syst. Tech. J., vol. 42, no. 2, March 1963, p. 415/430.

. . . paper extends the theory to the fourth order of perturbation theory, which allows one to estimate the available power from this process. . . .

Related Publications:

EFFECT OF REFLECTIONS ON THE OPERATION OF A BACKWARD WAVE TUBE (Translation)
V.N. Shevchik, et al., Radio Engng. Electronic Phys., vol. 8, Jan. 1963, p. 90/97, 15 refs., A63-25782.

. . . A theory due to Locherer and Bolz for the effect of reflections on oscillator operation is extended to include the losses in the delay system and the effect of the space-charge forces on the electron beam.

GENERATION OF MILLIMETER WAVES BY MEANS OF THE DOPPLER EFFECT
M.D. Sirkis, et al., IEEE Trans. Electron Devices, vol. ED-10, Nov. 1963, p. 417, A64-11706.

Review of an experiment in which the Doppler effect was used to produce radiation by means of a frequency conversion process at 39.7 Gc. . . .

3B.232: Traveling Wave Tubes in the Millimeter Wave Range

Included: PPM focused traveling wave tube; Ku-band traveling wave tubes.

Not Included: General theory of TWT operation.

Cross References: Low noise amplifiers (3B.250); Orthotron amplifier (3B.238).

Principal Publications:

STUDY OF MILLIMETER WAVE TUBES
J.E. Nevins, Jr., Hughes Aircraft Co., Malibu, Calif., Final rept., 12 Feb.-31 Oct. 1960, Dec. 1960, 22 p., incl. illus., table, 4 refs., AD 284 075.

. . . millimeter-wave traveling-wave tube. . . . need for special care in tube assembly so that minimum circuit loss and maximum tube efficiency can be obtained. High-area-compression electron-gun designs were investigated, and initial results demonstrated 92% transmission of a nominally 0.015-in. diam. electron beam through a 0.020-in. diam. drift tube.

STUDY OF FAILURE MECHANISMS IN HIGH POWER RADIO FREQUENCY GENERATING DEVICES
M.F. Axler, et al., General Telephone and Electronics Lab., Inc., Bayside, N.Y., Quarterly rept. no. 3, Rept. no. TR62-254.3, RADC TDR 62-615, 30 Sept. 1962, 33 p., incl. illus., tables, AD 400 150.

. . . causes of failures in gridded, high-power traveling-wave tubes are being studied through an examination of the gas ambient of operating tubes and of the individual tube components. . . .

35-KMC BEAM INTERACTION STUDY
C.E. Enderby, et al., Traveling Wave Tube Product Section, General Electric Co., Palo Alto, Calif., Interim engineering rept. no. 2, 20 June - 20 Sept. 1962, Rept. no. TIS R62ELM 233-2, 28 Sept. 1962, 18 p., incl. illus., AD 286 155.

Research continued on ring-plane slow wave circuits for use with high-perveance beams in traveling-wave tubes capable of operating above 35 kmc. . . .

STUDY AND APPLIED RESEARCH ON BEAM INTERACTION STRUCTURES FOR TRAVELING-WAVES TUBE
D.C. Forster, et al., Hughes Research Labs., Malibu, Calif., Final rept., 1 March 1961-28 Feb. 1962, ASD-TDR 62-612, Oct. 1962, 63 p., incl. illus., tables, AD 291 676.

A study of slow-wave propagating structures particularly suited for application at millimeter-wave frequencies . . .

DEVELOPMENT OF A MILLIMETER LOW-NOISE TRAVELINGWAVE AMPLIFIER
E.W. Kinaman, Watkins-Johnson Co., Palo Alto, Calif., Quarterly rept. no. 6, 1 March-31 May 1962, 15 June 1962, 7 p., incl. illus., AD 284 536, AD 282 070.

. . . The tests . . . showed excellent beam focusing through the helix to the collector. . . . A 40 decibel electronic gain was observed for the traveling-wave tube amplification at wavelengths in the 3-mm region.

DEVELOPMENT OF AN E-BAND AMPLIFIER
E.W. Kinaman, Watkins-Johnson Co., Palo Alto, Calif., Technical note no. 6, 1 April-30 June 1962, R ept. no. W-J 62-410R24, RADC TDR 62-424, July 1962, 11 p., incl. illus., table, AD 287 228.

. . . 30 db electronic gain at 78 kmc. In the filter area: 3 to 3.3 db resonant and insertion loss from 70 to 85 kmc at a 3 db bandwidth of 80 to 84 Mc. . . .

PRODUCTION REFINEMENT OF Ku-BAND TRAVELING-WAVE TUBES
G.W. Linn, et al., Traveling Wave Tube Product Section, General Electric Co., Palo Alto, Calif., Final technical engineering rept., Feb. 1960 - July 1962, Rept. no. TIS R62 ELM 186 10, ASD TR63 7 741, AD415 779.

PRODUCTION REFINEMENT OF Ku-BAND TRAVELING-WAVE TUBES
C.W. Linn, et al., Traveling Wave Tube Product Section, General Electric Co., Palo Alto, Calif. Application engineering rept., Feb. 1960-July 1962, ASD TR 63 7 741, vol. 2, AD 415 758.

THE UBITRON AS A HIGH-POWER MILLIMETER WAVE AMPLIFIER
R.M. Phillips, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 13/16.

. . . one can expect to obtain the same order of magnitude of power at 100 kmc from a Ubitron as one would obtain at 10 kmc from a conventional TWT.

3-MM WAVELENGTH LOW NOISE TRAVELING WAVE TUBE
A.W. Shaw, Watkins-Johnson Co., Palo Alto, Calif., Semiannual technical summary rept. no. 3, 1 Jan.-30 June 1962, 4 p., AD 407 882.

Efforts were continued on the development of a broadband, low-noise TWT amplifier in the 3-millimeter wavelength range. . . . tube produced the first encouraging results.

SUPERPOWER MILLIMETER WAVE TUBE
H.L. Thal, Superpower Microwave Tube Lab., General Electric Co., Schenectady, N.Y., Quarterly progress rept. no. 3, 1 Dec. 1961-28 Feb. 1962, 21 May 1962, 17 p., incl. illus., AD 289 898.

35-KMC BEAM INTERACTION STUDY
R.M. White, et al., Traveling Wave Tube Product Section, General Electric Co., Palo Alto, Calif., Interim engineering rept. no. 1, 30 March-20 June 1962, Rept. no. TIS R62ELM 233-1, 20 June 1962, 17 p., incl. illus., AD 277 485.

. . . properties of ring-plane slow-wave circuits for use with high-perveance beams in traveling-wave tubes capable eventually of operating above 35 kmc with a 10% minimum bandwidth, and promise of eventually possessing efficiencies greater than 10%.

3-MM WAVELENGTH LOW-NOISE TRAVELING-WAVE TUBE
Army Electronics Research and Development Lab., Fort Monmouth, N.J., Semiannual technical summary rept. no. 3, 1 Jan.-30 June 1962, 30 June 1962, 4 p., AD 289 279.

. . . to develop a broadband, low-noise TWT amplifier in the 3-millimeter wavelength range. The bandwidth is to be 50%, centered at 93.75

kmc. The objective noise figure is 10 db at band center, and 14 db at the band edges. . . .

DESIGN AND DEVELOPMENT OF THREE-WATT Ku-BAND TRAVELING-WAVE TUBE
Microwave Electronics Corp., Palo Alto, Calif., Interim Development Rept. 1, 1 July 1962 - 30 Sept. 1962, 12 p., incl. illus., AD 400 966.

BASIC RESEARCH IN MICROWAVE DEVICES AND QUANTUM ELECTRONICS
H.K. Detweiler, et al., Electron Physics Lab., Univ. of Michigan, Ann Arbor, Quarterly progress rept. no. 3, 1 Nov. 1963-1 Feb. 1964, Rept. no. 05772 3P, March 1964, 85 p., AD 437 793, AD 420 556.

. . . Analysis of Amplitude-and Phase-Modulated Traveling-Wave Amplifiers. . . .

RESEARCH ON MILLIMETER WAVE TUBES
D.C. Forster, et al., Hughes Research Labs., Malibu, Calif., Interim engineering rept. no. 3, 1 Oct.-31 Dec. 1963, 31 Dec. 1963, 39 p., AD 427 884, AD 421 401, AD 411 462.

. . . continuing program to build a 100-W cw amplifier at W-band . . . feasibility study of a 5 mm amplifier which eventually will deliver 30 W of cw power at 2 mm . . .

A 35,000 Mc/s STUB-SUPPORTED RING AND BAR TRAVELLING-WAVE TUBE
J.F. Gittins, et al., J. Electronics and Control, Aug. 1963, p. 145/163, 11 refs., A63-20430.

. . . has a power output of 10 watts, a gain of 25 db, and a fixed voltage bandwidth of 300 Mc. . . .

DEVELOPMENT OF AN E-BAND AMPLIFIER
E.W. Kinaman, Watkins-Johnson Co., Palo Alto, California, Technical note no. 8, 1 Oct.-Dec. 31, 1962, Rept. no. W-J-63-410R32, RADC TDR 63-46, 16 Jan. 1963, 10 p., incl. illus., AD 297 286.

Traveling wave tubes. One tube netted five decibel flange to flange gain at 80 gc.

DEVELOPMENT OF A MILLIMETER LOW-NOISE TRAVELING-WAVE AMPLIFIER
E.W. Kinaman, Watkins-Johnson Co., Palo Alto, Calif., Quarterly rept. no. 7, 1 June-31 Dec. 1962, 25 Jan. 1963, 26 p., AD 403 111.

. . . improvement in circuit and waveguide components . . . overall gain of 5 db at 80 gc. . . .

3-WATT Ku-BAND PPM-FOCUSED TRAVELING WAVE TUBE
T.H. Schultz, General Electric Co., Palo Alto, Calif., Interim engineering Progress rept. no. 1, 15 July 1963-30 Jan. 1964, Rept. no. TISR64 ELM251 1, 30 Jan. 1964, 26 p., AD 436 342.

. . . The second tube tested has a saturated power output greater than seven watts from 12 to 18 Gc, with a minimum saturated gain of 26 db. . . .

PROCEEDINGS OF THE HIGH-POWER MICROWAVE TUBES SYMPOSIUM HELD AT THE HEXAGON, FORT MONMOUTH, NEW JERSEY ON 25 AND 26 SEPTEMBER 1962. VOLUME I
New York U., N.Y., 1963, 319 p., AD 404 484.

. . . TWT amplifier . . . High power CW amplifier for 50-56 Gc frequency range; A 100-Gc, high-power, backward- wave oscillator . . .

DEVELOPMENT OF PPM-FOCUSED LOW-NOISE TRAVELING-WAVE TUBES FOR Ku-, K-, and Ka-BAND
Microwave Electronics Corps., Palo Alto, Calif., Interim development rept. 2, 1 Oct.-31 Dec. 1963, Feb. 1964, 24 p., AD 432 237.

Related Publications:

TRAVELING-WAVE-TUBE MIXER
L. Magill, Sperry Gyroscope Co., Great Neck, N.Y., Final rept., 1 April 1961-31 May 1963, Rept. no. NA8220 8366, March 1964, 37 p., AD 437 812.

. . . a two-helix traveling-wave-tube mixer capable of operation from 50 to 60 Gc. . . . technical difficulty arose from the use of molybdenum in the tube shell and support structure. . . . All brazing efforts failed, so a device was constructed and sealed by means of an epoxy adhesive.

3B. 238: Other Millimeter Tubes and Generators

Included: Orthotron; Millimeter backward wave oscillator; Multiple ladder circuit backward wave oscillator; Cyclotron resource generator; Carcinotron zero tubes; Millimeter C. W. carcinotron; O-type carcinotron; Klystrons above 30 Gc/s; Millimeter wave reflex klystron; Floating drift tube klystron; Magnetrons in the millimeter wave range; Osaka tube; Planotron; Cross-field amplifier; Racetrack microtron; Larmotron.

Not Included: Electron tube theory in general.

Cross References: TWT at millimeter waves (3B. 232).

Principal Publications:

TWO BACKWARD-WAVE OSCILLATOR TUBES FOR THE 29,000- TO 74,000-MEGACYCLE FREQUENCY RANGE
D. J. Blattner, et al., RCA Rev., vol. 19, no. 4, Dec. 1958, p. 584/597.

Two experimental tubes were built which demonstrated the feasibility of obtaining voltage-tunable oscillators having useful power output over very wide frequency ranges at millimeter wavelengths. . . . Extrapolation of the design indicates the possibility of tape-helix backward-wave oscillators delivering useful power at frequencies as high as 150,000 megacycles (2-millimeter wavelength). . . .

A NEW BACKWARD WAVE OSCILLATOR FOR THE 4 TO 5 MILLIMETER REGION
J. A. Noland, et al., Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 714/719.

THE CYCLOTRON RESONANCE BACKWARD-WAVE OSCILLATOR
K. K. Chow, et al., Proc. IRE, vol. 48, Nov. 1960, p. 1865/1870.

A PERIODICALLY FOCUSED BACKWARD-WAVE OSCILLATOR
C. C. Johnson, IRE Wescon Conv. Rec., vol. 3, Aug. 1960, p. 103.

DEVELOPMENT OF BACKWARD WAVE LOCAL OSCILLATOR TUBES
J. A. Noland, et al., General Telephone and Electronics Labs., Inc., Bayside, N. Y., Rept. no. TR60-202.8, 30 Dec. 1960, 1 v., AD 254 770.

. . . two backward wave oscillators having a combined tuning range of 64 to 102 Gc/sec . . . The design and constructional details of the final tubes and permanent magnet focusing structure are described . . .

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia Radiation Lab., New York, 16 Sept.-15 Dec. 1960, Quarterly progress rept. no. 4, Rept. no. CU-12-60 SC-78330 Physics, 46 p., AD 251 220.

Progress in the production of 2.6 mm magnetrons is described. . . .

MILLIMETRE WAVE RESEARCH
R. C. Bannerman, et al., E. M. I. Research Labs., Ltd., Gt. Brit., Rept. no. RF/274, Nov. 1961, 34 p., incl. illus., 15 refs., AD 270 044.

. . . application of the retarding-field oscillator to the generation of frequencies of 70 kmc and higher. Some of the basic limitations of high perveance guns are discussed.

THE LARMOTRON. A DC PUMPED QUADRUPOLE AMPLIFIER
G. Bernstein, et al., SFD Labs., Inc., Union, N. J., Interim rept. 1, June 1961, 52 p., AD 257 825.

. . . theoretical and experimental investigation . . . uses transverse deflection RF couplers . . . objective is operating frequency of 70kMc . . . objective is to achieve a CW power output of 10 watts over a 5% bandwidth.

ON BACKWARD-WAVE OSCILLATOR STABILIZATION
R. B. Clark, et al., Proc. IRE, vol. 49, Nov. 1961, p. 1697.

MILLIMETER OSAKA TUBE
S. Mito, et al., Osaka City U., Japan, 1961, 4 p., incl. illus., AD 289 220.

. . . designed to operate in 8 mm wave region, was constructed and tested with the purpose of finding the practical frequency limit in view of the fabricability of the tube. . . . practically possible to fabricate an operable tube in 2 mm wave region. . . . Since Osaka Tube is capable of dwarf wave operation, a number of oscillating modes exist over a wide range of anode voltage. . . .

STUDY OF PLATINOTRON DEVICES
L. J. Nichols, Raytheon Mfg. Co., Burlington, Mass., 15 April-14 July 1961 on QKS779, Quarterly rept. no. 1, Rept. no. PT-125, 14 July 1961, 20 p., AD 266 709.

. . . Emphasis shall be placed on obtaining CW power in excess of 100 watts in the region of 8.6 mm. This tube should have a minimum bandwidth of 10%. The QKS779 development has accomplished . . . Power output up to 5 watts CW and efficiencies up to 9.6% . . . a new type of matching network was designed for the QKS779 that will provide greater power handling capabilities in the transistion from the network to the waveguide.

APPLIED RESEARCH ON A HIGH-POWER MILLIMETER-WAVE GENERATOR
J. W. Sedin, Watkins-Johnson Co., Palo Alto, Calif., Rept 2, 1 Sept.-30 Nov. 1961, 13 Dec. 1961, 15 p., AD 268 517, AD 270 109.

. . . to demonstrate the feasibility of developing a backward-wave oscillator capable of generating 100 kw peak power and 1000 watts average power at 100 gc. A beam tester was completed and tested at voltages to 35 kv. Beam transmission of 95.5% was achieved through a 70 mil diameter drift tube 1 in. long by using auxiliary magnets to cancel leakage magnetic field in the region of the cathode . . .

THE LARMOTRON
W. C. Sylvernal, SFD Labs., Inc., Union, N. J., Interim rept. 2, Sept. 1961, 59 p., AD 267 550.

. . . a transverse deflection electron beam amplifier . . . Measurements were made at 70 kmc to estimate circuit attenuation.

ONE WATT O-TYPE CARCINOTRON FOR OPERATION AT 150 KMc/s
Centre de Physique, Electronique et Corpusculaire, France, Rept. WR 739, July 1961, AD 268 306.

. . . deliver output power larger than one watt, in CW operation at a wave-length of 2mm with a tuning range larger than 5% (7500 mc) . . .

RESEARCH ON 8 MILLIMETER M-TYPE CARCINOTRON TUBES
Centre de Physique, Electronique et Corpusclaire, France, Final rept., Rept. no WR 814, RADC TDR 62-116, Dec. 1961, 79 p., incl. illus., AD 275 008, AD 268 307, AD 254 426.

MEGAVOLT ELECTRONICS, SUB-MILLIMETER WAVE RESEARCH
Electrical Engineering Research Lab., U. of Illinois, Urbana, Annual rept. no. 2, 1 March-30 Nov. 1961, Tech. note no. 3, ASD TDR 62-589, 1 Dec. 1961, 177 p., incl. illus., tables, 31 refs., AD 282 430.

Design studies on a 35 kmc, 1 mev electron accelerator and buncher are presented. . . . metal disk-loaded wave-guide 25 centimeters long, operating with a field strength of the order of 40 to 50 kv/cm, under a drive power of 100 kilowatts. The objective is to produce harmonic current frequencies in excess of 1,000 kmc, to drive beam-coupling structures and produce submillimeter wave power. . . .

MEGAVOLT ELECTRONICS, SUB-MILLIMETER WAVE RESEARCH
Electrical Engineering Research Lab., U. of Illinois, Urbana, Annual rept., 1 March 1960-28 Feb. 1961, 1 March 1961, 113 p., incl. illus., table, AD 267 843.

Research on the Cerenkov radiation approach to the . . . submillimeter generation problem is described. The method involves a combination of megavolt electronics and physical optics type technique. A scalar dielectric Cerenkov coupler operating at 8.31 millimeters wavelength produced 58 milliwatts per centimeters using a drive current of 43 milliamperes. The analysis and preliminary design of Cerenkov experiments in tensor media (ferrites, plasmas) is presented which shows promise of producing upwards of 100 watts with a 10 milliampere beam. Initial numerical analysis for a relativistic electron bunching accelerator (Rebatron) operating above 3 kmc is presented.

REPORT ON RESEARCH PROJECTS. RP7/8 KLYSTRON EFFICIENCY STUDIES: RP7/15 ELECTRON BEAM FREQUENCY MULTIPLIER FOR GENERATING MILLIMETRE WAVES
E. A. Ash, et al., Standard Telecommunications Labs., Ltd., Gt. Brit., Dec. 1962, 1 v., incl. illus., tables, 3 refs., AD 294 390

3.2 MILLIMETER WAVE MAGNETRON TUBE RESEARCH AND DEVELOPMENT
A. J. Bamford, et al., Westinghouse Electric Corp., Elmira, N. Y., Quarterly progress rept. no. 2, 1 Oct.-31 Dec. 1962, 31 Dec. 1962, 31 p., AD 401 492, AD 292 708.

THE LARMOTRON
G. Bernstein, et al., SFD Labs., Inc., Union, N. J., Interim engineering rept. no. 6, Rept. no 5A-IER-6, Sept. 1962, 16 p., incl. illus., refs., AD 284 056, AD 292 112, AD 276 948.

RECENT PROGRESS ON CARCINOTRON ZERO TUBES (In French)
C. Biguenet, Onde Electr., vol. 42, no. 424/5, July/Aug. 1962, p. 603/612.

The Carcinotron Zero is an oscillator tube for centrimetric and millimetric waves delivering a UHF power of the order of 100 mW and having a tuning range of about one octave obtained by a simple variation of the voltage applied on the line.

RESPONSE OF KLYSTRONS TO NANOSECOND PULSES
N. Bose, Cornell U., School of Electrical Engineering, Ithaca, N. Y., 30 Sept. 1962, 69 p., AD 406 923.

CYCLOTRON RESONANCE INTERACTION AT MILLIMETER WAVELENGTHS

K. K. Chow, Microwave Lab., Stanford U., Calif., Technical rept., Scientific rept. no. 43, ML rept. no. 918, AFCRL 62-582, Aug. 1962, 46 p., incl. illus., 21 refs., AD 286 326.

. . . between an electron beam and a circuit wave to produce backward wave oscillation in an unloaded waveguide in the S-band . . . development of a prototype oscillator tube to work in the 6-4.5 mm range . . .

TRANSVERSE WAVE TUBES FOR THE MILLIMETER BAND

J. Feinstein, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 17/20.

RESEARCH AND DEVELOPMENT LONG LIFE K-BAND CO-AXIAL MAGNETRON

P. Fenster, et al., SFD Labs., Inc., Union, N. Y., Quarterly technical rept. no. 4, 1 July 1961-1 July 1962, SFD rept. no. 16-An-1, July 1962, 52 p., incl. illus., tables, AD 284 819.

LINEAR BEAM TUBES AT MILLIMETER WAVELENGTHS

D. C. Forster, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 2/12.

SUPERPOWER MILLIMETER WAVE TUBE

P. N. Hess, Superpower Microwave Tube Lab., General Electric Co., Schenectady, N. Y., Quarterly progress rept. no. 2, 1 Sept.-30 Nov. 1961, 10 Feb. 1962, 17 p., incl. illus., AD 289 894.

THEORETICAL DESIGN OF A 35 Gc REBATRON

T. Hosona, Electrical Engineering Research Lab., U. of Illinois, Urbana, Technical note no. 5, ASD TDR 62-998, 1 Dec. 1962, 74 p., incl. illus., tables, 7 refs., AD 292 668.

. . . a rebatron (relativistic electron bunching accelerator) of the linear accelerator type to operate at 35 gc is described. . . .

INTERESTING BEHAVIOR OF VA-99 AS A MILLIMETER-WAVE AMPLIFIER (Correspondence)

K. Ishii, Proc. IRE, vol. 50, no. 12, Dec. 1962, p. 2510.

. . . to report interesting behavior of a reflex klystron VA-99 when this is used as a millimeter-wave amplifier. . . .

HIGH POWER MILLIMETER WAVE GENERATION

I. Kaufman, et al., STL, Inc., Canoga Park, Calif., Final rept., Rept. no. 8606-6017-RU-000, RADC TDR62-353, 25 June 1962, 62 p., incl. illus., 12 refs., AD 284 257.

The device investigated is the bermutron. In this device, an electron stream is deflected by an r.f. deflection system, so that the resulting pattern is similar to that traced out by a searchlight. When the deflected beam is passed through a region in which an electro-magnetic field of correct polarization can travel with a phase velocity equal to the beam sweep speed, power of a frequency that is a harmonic of the deflection frequency can be generated. The principle of operation was demonstrated at microwave frequencies with low output.

DESIGN AND CONSTRUCTION OF A 50-67 kMc/s CYCLOTRON RESONANCE BACKWARD-WAVE OSCILLATOR

W. B. Lindsay, Microwave Lab., Stanford U., Calif, ML rept. no. 925, July 1962, 109 p., incl. illus., tables, 34 refs., AD 282 437.

STUDY OF PLANTINOTRON DEVICES

L. J. Nichols, Raytheon Co., Burlington, Mass., Final engineering rept., 15 April 1961-15 April 1962 on QK 779, Rept. no. PT-289, 15 April 1962, 50 p., incl. illus., table, AD 281 814, AD 274 755.

. . . to obtain CW power in excess of 100 watts in the region of 8.6 millimeters. . . . minimum bandwidth of 10%. . . . Average power output of up to 68 watts was obtained at 30 gc. Efficiencies of up to 26% were measured.

BL-221 70 Gc MAGNETRON PRODUCTION ENGINEERING MEASURE

G. G. Riska, Bomac Labs., Inc., Beverly, Mass., Quarterly progress rept. no. 3, 6 Feb.-6 May 1962, 6 May 1962, 26 p., incl. illus., tables, AD 287 856.

Minor constructional modifications in the present BL-221 magnetron . . . Facilities capable of producing at a rate of 50 tubes per month are contemplated. . . .

AUTOMATIC PHASE CONTROL OF MICROWAVE OSCILLATORS

P. E. Robillard, Defense Research Telecommunications Establishment, Canada, Rept. no. 1098, April 1962, 23 p., 15 refs., AD 402 222.

APPLIED RESEARCH ON A HIGH POWER MILLIMETER-WAVE GENERATOR

J. W. Sedin, Watkins-Johnson Co., Palo Alto, Calif., Interim engineering rept. no. 6, 1 Sept.-30 Nov. 1962, 30 Nov. 1962, 27 p., incl. illus., tables, 2 refs., AD 295 005, AD 274 718.

. . . feasibility of generating very high power, specifically, 100 kw peak and 1000 watts average, at 100 kmc by means of an 0-type backward-wave oscillator operating at very high voltage.

C. V. D. RESEARCH PROJECT RP3-28; 2 mm C. W. OSCILLATOR
W. Smith, et al., General Electric Co., Ltd., Gt. Brit., Final rept., Rept. no. 14262, 8 Nov. 1962, 10 p., illus., 5 refs., AD 293 813.

Research was directed towards the production of an electrostatically focused BWO to operate over the band 130 - 150 gc with an output power of 5 mw cw. . . .

PRECISION FREQUENCY CONTROL OF A HIGH-POWER MILLIMETER KLYSTRON
C. M. Steinmetz, Lincoln Lab., MIT, Lexington, AFESD TDR 62-65, 3 Jan. 1962, 26 p., incl. illus., AD 273 509.

. . . 35 kmc 30-watt cw transmitter that uses a folating-drift- tube klystron oscillator . . . The system, both frequency and phase, locks the klystron oscillator to a low-power stable oscillator. An analysis of the phase-locked system is made and schematic diagrams are presented for the complete system. . . . The spectral width is about 50c. . . .

GENERATION OF SUB-MILLIMETER RADIATION BY A BUNCHED BEAM OF RELATIVISTIC ELECTRONS
P. A. Szente, Microwave Lab., Stanford U., Calif., Technical rept., M. L. rept. no. 935, July 1962, 126 p., incl. illus., 17 refs., AD 282 146.

The interaction of a bunched beam of relativistic electrons with several different microwave circuits was analyzed, with a view toward the generation of electromagnetic radiation in the sub-millimeter wavelength region. Because of relativistic effects, it was possible to use structures which had dimensions large compared to the desired wavelength. A relativistic electron beam was obtained from a traveling-wave linear accelerator which operated at a frequency of 9288 Mc/sec. . . . approximately 150 milliwatts were generated at 5.4 millimeters, and 35 milliwatts at one millimeter. The shortest wavelength observed was 0.4 millimeter at a power level of 40 microwatts.

GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS
Y. Ta, Compagnie Generale de Telegraphie sans fil, Paris, France, Technical Note No. 1, RADC-TDR-64-29, 31 Oct. 1962, 6 p., refs., AD 428 576, N64-15058.

High-frequency waves over the range of 541 to 612 Gc/s have been obtained by a recent CSF 0.5 mm carcinotron at the milliwatt level.

SUPERPOWER MILLIMETER WAVE TUBE
H. L. Thal, Superpower Microwave Tube Lab., General Electric Co., Schenectady, N. Y., Quarterly progress rept. no. 4, 1 March-31 May 1962, 31 May 1962, 18 p., incl. illus. AD 289 893, AD 294 850, AD 289 897.

The new X-band Orthotron was designed in detail. The anode has twelve uniform cavities and has an active length of 5.6 inches or four wavelengths. . . .

MILLIMETER WAVE TRANSMITTER TUBE
J. R. M. Vaughan, General Electric Co., Schenectady, N. Y., Final rept., 1 July 1961-31 March 1962, Rept. no. 3, 31 March 1962, 43 p., incl. illus., 7 refs., AD 281 925.

. . . a 94 kmc gas-filled cold-cathode magnetron. Constructional details and test results are given for three magnetron diodes based on this design. . . .

COHERENT SUB-MILLIMETER GENERATOR FEASIBILITY STUDY
G. E. Weibel, et al., General Telephone and Electronics Labs., Inc., Bayside, N. Y., Final rept., 11 Jan.-20 Nov. 1961 on Radiation Weapons, Aug. 1962, 133 p., incl. illus., refs., AD 286 885.

. . . operation of the Tornadotron at wavelengths about one mm. and shorter is reported. The Tornadotron is an electron tube device that generates pulsed electromagnetic radiation in a cycle of operations involving trapping of electrons, cyclotron pumping and pulsing with high magnetic fields. Work is described on magnetic pulsing of the Tornadotron with fields up to 25 kilogauss and on monitoring of the emitted radiation. Output was detected up to slightly above 70 kmc . . .

EXPERIMENTAL TUBE GENERATES MILLIMETER WAVES
Electronics, vol. 35, no. 8, Feb. 1962, p. 56/58.

Experimental backward wave oscillator tube indicates that existing microwave concepts can be extended to the millimeter wave portion of the spectrum. The tube, designed for operation at frequencies from 50 to 75 Gc, generated 1.6 watts of c-w output power under laboratory conditions . . .

PULSED MAGNETIC FIELD MILLIMETER WAVE GENERATOR
Microwave Lab., Stanford U., Calif., Final rept., 1 Dec. 1959-30 Sept. 1962, ML rept. no. 989, Dec. 1962, 103 p., incl. illus., table, AD 297 144, AD 283 034.

A pulsed magnetic field was used to store energy in a ferrite, which can be sequentially delivered as a coherent pulsed signal to a circuit at a microwave or millimeter-wave frequency. A series of such generators is described . . . A digital computer procedure is summarized which solves the equations of motion in a ferrite, under the influence of pulsed magnetic fields, under very general conditions. A theoretical and experimental investigation of the possibilities for the generation of electromagnetic shock waves in ferrites is summarized.

SLOW-WAVE STRUCTURES FOR MILLIMETRE-WAVELENGTH BACKWARD-WAVE OSCILLATORS
E. A. Ash, et al., Elect. Commun., vol. 38, no. 2, 1963, p. 264/275, 18 refs., A63-18241.

FINAL REPORT RP 7/15 ELECTRON BEAM FREQUENCY MULTIPLIER FOR GENERATING MILLIMETER WAVES
E. A. Ash, et al., Standard Telecommunications Labs., Ltd., Gt. Brit., Sept. 1963, 1 v., AD 429 877.

LONG LIFE K-BAND MAGNETRON
N. Balmuth, et al., Microwave Associates Inc., Burlington, Mass., Final rept., 1963, 63 p., AD 405 166.

DEVELOPMENT OF A MILLIMETER WAVE GENERATOR USING A FIELD EMISSION CATHODE
J. P. Barbour, et al., Field Emission Corp., McMinnville, Oreg., RADC TDR63 317, Aug. 1963, 21 p., AD 417 279, N63-22069.

. . . six month feasibility study . . . to determine if an electron gun using a field emission cathode can be developed which will generate an electron beam of suitable diameter and conductance for a 70 gc oscillator. A floating drift type klystron was chosen as the most suitable device. . . . characteristics would be adequate for a floating drift tube klystron operating at 70 gc.

THE LARMOTRON A TRANSVERSE WAVE AMPLIFIER
G. Bernstein, et al., SFD Labs., Inc., Union, N. J., Final rept., Feb. 1961-May 1963, ASD TDR 63 763, July 1963, 34 p., AD 420 146.

. . . theoretical and experimental investigation . . . on the feasibility of developing a millimeter wave Larmotron amplifier. The Larmotron is a cyclotron wave electron beam amplifier. Nine amplifier tubes were built. Gains of over 10 db were achieved. The characteristics of two alternate forms of dc pumping were explored . . . Two major limiting problems arose . . .

A LISSAJOU FIGURE SYSTEM FOR MONITORING THE FREQUENCY STABILITY OF 35 GC PHASE-LOCKED KLYSTRON OSCILLATORS
W. E. Blore, et al., Defense Telecommunications Establishment, Canada, Rept. no. 1102, Feb. 1963, 16 p., AD 402 079.

A 30-40 kMc MULTIPLE LADDER CIRCUIT BACKWARD WAVE OSCILLATOR
L. S. Bowman, et al., Utah U., Microwave Devices Lab., Salt Lake City, In its Microwave Devices Lab., Consolidated Quarterly Report March 31, 1963, p. 1/5, 1 ref., N63-18702.

3.2 MILLIMETER WAVE MAGNETRON TUBE RESEARCH AND DEVELOPMENT
A. J. Bramford, et al., Westinghouse Electric Corp., Elmira, N. Y., Quarterly progress rept. no. 3, 31 March 1963, 31 p., AD 408 709.

Two 93 kmc rf assemblies were fabricated . . .

MILLIMETER ELECTROMAGNETIC RADIATION PRODUCED BY HIGH ENERGY ELECTRON BEAMS
E. Brannen, Western Ontario U., Canada, Final rept., 1 Nov. 1961-31 Jan. 1963, 31 Jan. 1963, 9 p., AD 431 119.

. . . generation of millimeter and submillimeter waves with bunched megavolt electron beams, through the interaction with Cerenkov and transition radiators. . . .

MODULATION OF A MILLIMETER WAVE REFLEX KLYSTRON BY NOISE (Correspondence)
A. L. Brault, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 243/244.

Because of high-noise figures and low sensitivities of amplifiers and receivers at M band (50-75 kMc), a standard gas discharge noise source is usually unusable. . . . promising results . . . modulation of a millimeter wave reflex klystron by a lower frequency noise source. . . .

INJECTION PHASE LOCKING OF A MILLIMETER BACKWARD WAVE OSCILLATOR
W. R. Day, Jr., Proc. IEEE, vol. 51, no. 7, July 1963, p. 1039.

. . . This method of obtaining a stable signal at millimeter wavelengths affords the advantages of simplicity and economy over electronic stabilizing loops. . . .

PRODUCTION ENGINEERING MEASURE FOR A Ka-BAND INVERTED COAXIAL MAGNETRON
P. du Fosse, et al., SFD Labs., Inc., Union, N. J., Quarterly progr. rept. no. 2, 7 Aug.-6 Nov. 1963, Nov. 1963, 28 p., AD 429 053.

RESEARCH AND DEVELOPMENT LONG LIFE K-BAND COAXIAL MAGNETRON
P. du Fosse, et al., SFD Labs., Inc., Union, N. J., Quarterly progress rept. no. 9, 1 July-1Oct. 1963, Rept. no. 16QPR9, Oct. 1963, 25 p., AD 434 273.

. . . for use in airport radars. Two new 24 Gc ICEM coaxial magnetrons were constructed and evaluated . . .

RESEARCH AND DEVELOPMENT LONG LIFE K-BAND COAXIAL MAGNETRON
P. Fenster, SFD Labs., Inc., Union, N. J., Quarterly progress rept. no. 7, 1 Jan-1 April 1963, April 1963, 16 p., SFD Rept. no. 16-QPR-7, AD 414 575.

. . . One of the latest of the tubes built as a result of this effort, C2E, operated at about 70 kw and 25% efficiency when externally loaded. This tube, however, operated at 23.24 Gc and the frequency must be moved up less than 2.5% in order to move it into the required frequency band. . . .

A RACETRACK MICROTRON FOR MILLIMETER AND SUBMILLIMETER WAVE GENERATION
H. Froelich, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 288/291, A64-11514.

. . . description of an eight-orbit four-sector racetrack microtron possessing strong focusing action. The magnet gap is only 7 mm, and the accelerating cavity is placed in one of the field-free regions. . . .

DEVELOPMENT OF ECONOMIC QUANTITY/QUALITY MANUFACTURING METHODS FOR A Ka-BAND TUNABLE MAGNETRON
G. E. Glenfield, et al., SFD Labs., Inc., Union, N. J., Interim technical documentary progress rept., 21 Dec. 1963-March 1964, 21 March 1964, 27 p., AD 434 150.

DEVELOPMENT OF BROADBAND INTEGRATED COVERAGE BACKWARD WAVE OSCILLATORS
O. L. Hoch, et al., Litton Electron Tube Corp., San Carlos, Calif., Final technical engineering rept., 7 Jan. 1958-15 Aug. 1960, ASD TR63 7 652, vol. 2, March 1963, 155 p., AD 416 789.

ENGINEERING AND PRODUCTIZATION OF AN INTEGRATED FAMILY OF BACKWARD WAVE OSCILLATORS
P. Janis, et al., Raytheon Co., Burlington, Mass., Final rept., 7 July 1961-7 July 1963, Rept. no. PT675, AD 431 579, AD 431 580 (vol. 2).

A family of electrically and mechanically compatible electronically tunable M-type backward-wave oscillators has been developed. . . . Raytheon has developed production capability covering seven of the nine frequency bands outlined in the ASD Coordinated exhibit. . . .

70 GC KLYSTRON FREQUENCY STABILITY AND SPECTRUM
J. E. Kammerer, et al., Ballistic Research Labs., Aberdeen Proving Ground, Md., BRL MR1457, March 1963, 21 p., AD 404 868.

HIGH POWER ELECTRONICS (Translation)
P. L. Kapitza, Soviet Physics - Uspekhi, vol. 5, March-April 1963, p. 777/826, A63-19232.

. . . direct power generation through the use of microwave electronics. . . . to convert direct current into high-frequency oscillations, but also to change high-frequency oscillations into direct current. . . . A possible device . . . with the aid of a planotron is described.

RESEARCH AND DEVELOPMENT ON HIGH-POWER CRESTATRONS FOR THE 100-300 MC FREQUENCY RANGE
G. T. Konrad, Electron Physics Lab., U. of Michigan, Ann Arbor, Quarterly progress rept. no. 12, 1 April-1 July 1963, July 1963, 25 p., AD 414 495.

. . . The aim is to construct compact 100-watt Crestatrons employing permanent magnet focusing. . . .

DEVELOPMENT OF ECONOMIC QUANTITY/QUALITY MANUFACTURING METHODS FOR A Ka-BAND TUNABLE MAGNETRON
P. Laurendeau, et al., SFD Labs., Inc., Union, N. J., Interim rept., 21 March-21 June 1963, 21 June 1963, 49 p., AD 414 153.

. . . capable of meeting airborne environmental requirements . . . Problem areas studied are increased power output, broad tuning band, mechanical ruggedness for environmental requirements and cost reduction of manufacturing processes. . . .

DEVELOPMENT OF A Ku-BAND CROSSED-FIELD AMPLIFIER
J. McBride, et al., SFD Labs., Inc., Union, N. J., Interim rept. no. 1, 27 June-30 Sept. 1963, Rept. no. 321DR1, Oct. 1963, 22 p., AD 428 495, AD 430 138.

. . . the amplifier circuit best suited for this program is a choke supported interdigital line. . . . has been proved electronically sound at X-band . . . it is readily scalable to higher frequencies. . . .

THE OSAKA TUBE AS AN OSCILLATOR IN THE SHORT MILLIMETER WAVES
A. Mijrai, et al., Osaka U., Japan, 30 May 1963, 9 p., AD 405 968.

A Barkhausen-Kurz type electron tube with a confining d. c. magnetic field, the so-called Osaka Tube . . . to operate at 2.5 mm wave length with a purpose to study the possibility of its practical fabricability . . . magnetic field of 4,000 gauss and an anode voltage of 800 volts . . . Problems still remain in the mechanical tuning construction . . .

APPLIED RESEARCH ON A HIGH-POWER MILLIMETER-WAVE GENERATOR
M. V. Purnell, Watkins-Johnson Co., Palo Alto, Calif., Interim engineering rept. no. 8, 1 March-31 May 1963, 36 p., AD 407 324.

. . . to demonstrate the feasibility of generating very high power specifically 100 kw peak and 1000 watt average at 100 Gc by means of an 0-type backward-wave oscillator operating at very high voltage.

BL-221 70 Gc MAGNETRON PRODUCTION ENGINEERING MEASURE
G. G. Riska, Bomac Labs., Inc., Beverly, Mass., Quarterly rept. no. 9, 6 Aug.-6 Nov. 1963, 6 Nov. 1963, 28 p., AD 430 570.

APPLIED RESEARCH ON A HIGH-POWER MILLIMETER-WAVE GENERATOR
J. W. Sedin, et al., Watkins-Johnson Co., Palo Alto, Calif., Rept. for June 1961-Aug. 1963, Aug. 1963, 141 p., AD 428 241, N64-15061.

. . . an 0 type backward-wave oscillator operating at very high voltage. A disc-loaded waveguide which operates from 90 kv to 200 kv was selected as the circuit for the backward wave oscillator. . . . The power density in the beam was 280 megawatts per square cm. Peak power of 107 kilowatts was measured using a calorimeter as a power standard. . . . Both of these power levels exceed any other known values of power at a frequency of 100 Gc. (See also AD 299 974.)

MEGAVOLT ELECTRONICS, SUB-MILLIMETER WAVE RESEARCH
M. D. Sirkis, et al., Illinois U., Engineering Experiment Station, Urbana, Annual rept. no. 4, 1 Sep 62-31 Aug 63, Dec. 1963, 144 p., AD 428 806.

Generation of millimeter wavelength radiation by means of the Doppler effect is discussed. In contrast to other rebatron experiments, the output frequency need not be a harmonic of the rebatron frequency and is therefore potentially tunable. Power has been generated at 39.7 Gc at the milliwatt level in substantial agreement with theory. . . .

GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS
Yeou Ta, Centre de Physique, Electronique et Corpusculaire (France), Interim technical rept. no. 2, 1 Oct-31 Dec 63, Rept. no. WR1137, RADC TDR 64 65, 31 Dec. 1963, 7 p., AD 428 777, N64-15060.

. . . extension of the state of the art of 0-type carcinotron oscillators to the generation of submillimeter waves down to 0.3 mm. . . . center frequency . . . 950 Gc/s; bandwidth . . . 5 to 10%; power output with 10 milliwatts c.w.; maximum voltage with 10,000 volts; magnetic field with 7000 gauss . . . (See also AD 428 778, N64-15059; AD 428 576.)

SUPERPOWER MILLIMETER WAVE TUBE
H. L. Thal, Superpower Microwave Tube Lab., General Electric Co., Schenectady, N.Y., Quarterly progress rept. no. 3, Jan - 15 Apr 63, 23 p, AD 411 365.

. . . aimed at generating large amounts of RF power in the region of 70-100 kilomegacycles. The immediate objective is the demonstration of Orthotron (a crossed-field microwave generator) operation at X-band with models which are scalable to millimeter wavelengths according to the power times frequency squared scaling law . . . (See also AD 400 676, AD 427 796.)

EXPERIMENTAL CW KLYSTRON FOR MULTIPLICATION FROM 30 TO 2.5 MILLIMETERS (Correspondence)
B. B. van Iperen, Proc. IEEE, vol. 51, no. 6, June 1963, p. 935/937.

. . . delivering an output power of 30 mw at a wavelength of 2.5 mm with a driving power of 12 w at 30 mm, corresponding to a mean conversion loss of 2.2 db per harmonic . . . The tube operates at a beam voltage of 24 kv and is adapted to permit of scaling down. . . .

HIGH POWER CYCLOTRON RESONANCE GENERATOR
H.M. Waddell, et al., General Electric Co., Ltd. (Gt. Brit.) Annual rept. no. 4, Rept. no. 14 528C, Jan. 1964, 25 p., AD 431 715.

. . . M-type backward wave oscillators . . . which are particularly suited for frequencies higher than J-band. . . . practical problems encountered in attempting to realise the Q-band design . . . Q-band power is generated, broadly as anticipated, over the range 26.5 to 40 Gc/s, the highest recorded being one watt at 39.38 Gc/s. . . .

DEVELOPMENT OF ELECTRONICALLY-TUNABLE CONVERTERS IN THE MILLIMETER-WAVE RANGE
R.W. Wilmarth, et al., ITT Corp., Easton, Pa. ITT Electron Tube Div., Bimonthly Report No. 4, 16 Jan.-16 Mar. 1964, 1964, 7 p., N64-18438.

. . . slow-wave structure for the backward-wave tubes, in the 50- to 75 gc range, suitable for operating a single-circuit converter and three double-circuited experimental backward-wave converters . . .

RESEARCH ON ONE MILLIMETER C. W. CARCINOTRON
Compagnie Generale de Telegraphie sans Fil, Paris (France), Technical Report No. 5, (RADC-TR-63-551), Oct. 1963, 7 p., AD 426 353, N64-13638.

. . . center frequency of 300 kmc/s, bandwidth of 5% to 10% power output of 1 watt cw, high voltage of 10 kv (max.), efficiency of 0.5% and focusing by electromagnetics . . . (See also AD 419 452, AD 409 108, AD 299 302.)

PROCEEDINGS OF THE HIGH-POWER MICROWAVE TUBES SYMPOSIUM HELD AT THE HEXAGON, FORT MONMOUTH, NEW JERSEY ON 25 AND 26 SEPTEMBER 1962. VOLUME I.
New York U., N.Y., 1963, 319 p., AD 404 484.

. . . A 100-Gc, high-power, backward-wave oscillator . . .

Related Publications:

MEGAVOLT ELECTRONICS, SUB-MILLIMETER WAVE RESEARCH
J.R. Baird, et al., Electrical Engineering Research Lab., U. of Illinois, Urbana, Annual rept. no. 3, 1 Dec 61-31 Aug 62, Technical note no. 6, 1 Dec. 1962, 39 p. incl. illus., 9 refs., AD 293 827.

Design data for a 1 mev disk-loaded linear electron accelerator and buncher which is being designed to operate at 35 Gc . . . Beam coupling studies which are described are based upon these effects: (1) Cerenkov interaction in a plasma, (2) Cerenkov interaction in a ferrite, and (3) transition radiation. Calculated data are presented which show that interaction resistances greater than 1000 ohms per wavelength are possible.

ON "MICROWAVE NOISE FIGURE MEASUREMENT FOR SMALL NOISE OUTPUT" (Correspondence)
M. Lebenbaum, et al., Proc. IEEE, vol. 51, no. 5, May 1963, p. 860/862.

Section 3B.24

3B.240: Other methods for Millimeter Wave Generation

Included: Microwave generation by photo-mixing; Photoelectric mixing for millimeter wave generation; Coherent light photo-mixing; Optical mixing in phototubes for infrawave generation; Optical heterodyning; Generation of millimeter waves by optical pumping; Non-linear semiconductors as millimeter wave generators; Ferro-magnetic millimeter wave generators.

Not Included: Phototubes; Theory of ferromagnetism.

Cross References: Optical masers (Sect. 3B.34); Converters and mixers at millimeter waves (3B.264); Traveling wave phototubes as microwave detectors (3B.265).

Principal Publications:

ELECTRON TUBES AND DEVICES IN THE 4.3-mm FREQUENCY RANGE
H. J. Hersh, IRE Trans. Mil. Electronics, vol. MIL-4, no. 4, Oct. 1960, p. 481/492.

MILLIMETER-WAVE-MASER RESEARCH
C. K. Asawa, et al., Hughes Research Labs., Malibu, Calif., Final rept., 1 July 1961/30 June 1962, Rept. no. 4, 30 June 1962, 56 p., incl. illus., tables, 9 refs., AD 284 412.

An experiment to demonstrate the ruby laser in optically pumping a ruby microwave maser was successful. Microwave generation and amplification due to population inversion in the ground state of ruby at 4.2 K were produced by spectrally matching an absorbing optical transition in the Zeeman structure of the maser crystal to a component of the laser emission. . . . An X-band reflection-type maser, with a 90 degree crystal axis to magnetic field orientation, was constructed and successfully operated.

FUNDAMENTAL RESEARCH ON ELECTROMAGNETIC THEORY AND MICROWAVE SPECTROSCOPY
G. Toralso di Francia, et al., Florence U., Italy, March 1962, 46 p., incl. illus., 15 refs., AD 284 479.

Methods for extracting millimetric and submillimetric power from an electron beam were investigated. . . . the problem is to find the way to convert into radiated power as much as possible of the desired harmonic and to isolate it with respect to the others. In principle, this may be attained if the particle field is subjected to a frequency-dependent transformation, like diffraction. From this point of view, the problem arises of finding the diffracting structure which presents the best performance.

THEORETICAL CONSIDERATIONS ON MILLIMETER WAVE GENERATION BY OPTICAL FREQUENCY MIXING
J. R. Fontana, Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1796/1880.

. . . mixing optical maser signals . . . for closing the gap between microwaves and infrared. . . . conversion efficiency attainable with different types of nonlinear media is considered. . . .

GENERATION AND RADIATION OF ULTRA-MICROWAVES BY OPTICAL MIXING (Correspondence)
O. P. Gandhi, Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1829/1830.

The presence of small nonlinearity in the dielectric constant of optically transparent materials has recently been used for optical mixing of focused pulsed laser beams producing intense electric fields of the order of 10^5 volts/cm and above.

MICROWAVE PHOTOMIXING OF OPTICAL MASER OUTPUTS WITH A PIN-JUNCTION PHOTODIODE (Correspondence)
H. Inaba, et al., Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1823/1824.

. . . have detected signals from UHF through X band produced by photomixing between axial-mode components of ruby lasers. . . .

OPTICAL MIXING IN PHOTOTUBES (Correspondence)
P. A. Lindsay, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2380/2381.

MILLIMETER WAVES ARE GENERATED WITH FERRITES
Electronics, vol. 35, no. 5, Feb. 1962, p. 58/60.

Harmonic generation using ferromagnetic resonance has produced 60 watts output at 70 Gc and comparable output is expected at 140 Gc.

MILLIMETER WAVE GENERATION BY MULTIPLE QUANTUM TRANSITIONS
H. G. Anderson, Army Electronics Research and Development Agency, Fort Monmouth, N.J., AELRDL TR2388, Sept. 1963, 15 p., AD 426 998.

DESIGN AND DEVELOPMENT OF A PHOTOMIXING DEVICE
D. E. Caddes, Sylvania Electric Products, Inc., Mountain View, Calif., Final rept., AFCRL 63 379, 9 Aug. 1963, 66 p., AD 422 961.

A traveling-wave phototube (TWP) has been developed which is capable of photomixing optical signals of differing frequency content and detecting the resultant difference frequency signal (beat) over the 11 to 20 Gc band. This represents the broadest bandwidth presently available in a practical photodetector. . . .

A SLOW-WAVE STRUCTURE AT ULTRA-MICROWAVES (Correspondence)
O. P. Gandhi, Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 372.

. . . A semiconductor plasma can, therefore, be used as a slow-wave medium in the ultra-microwave region. . . .

NONLINEAR SEMICONDUCTORS AT MILLIMETER FREQUENCIES
R. I. Harrison, et al., General Telephone & Electronics Labs., Inc., Bayside, N.Y., Quarterly rept. no. 2, 1 Sept.-30 Nov. 1963, Rept. no. TR 63 102 2, 30 Dec. 1963, 45 p., AD 431 711.

A more rigorous theory for the thermoelectric effect of hot carriers was developed which does not depend upon the assumption of a Maxwell-Boltzmann distribution for the hot carriers. . . . Measurements were made of the thermoelectric effect in n-type epitaxial silicon at room temperature using 70-Gc excitation. . . . The nonlinear conductivity of germanium in high field was used to generate the third harmonic of a pulsed 70-Gc signal. There was a good qualitative fit between an analytic curve of the conversion efficiency vs field and the observed behavior of the efficiency. The maximum efficiency obtained was -49.6 db and the maximum output at 210 Gc was 0.764 mW.

MILLIMETER WAVE GENERATION USING FERROMAGNETIC MATERIALS
G. L. Heiter, Microwave Lab., Stanford U., Calif., Rept. no. 1090, Oct. 1963, 228 p., AD 429 717.

. . . using pulsed magnetic fields as the energy source . . . Two specific types of generators were studied. . . .

COHERENT LIGHT DETECTION IN SOLID-STATE PHOTODIODES
G. Lucovsky, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 166/172.

. . . Output mixed frequencies to 100 kMc can be obtained in appropriately designed structures. Experimental results verifying the existence of photomixing in Si, Ge, GaAs and InAs photobodies are presented.

PHOTOELECTRIC MIXING OF COHERENT LIGHT IN BULK PHOTOCONDUCTORS (Correspondence)
G. Lucovsky, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 613/614.

AN EXPERIMENTAL PHOTOMIXER IMAGE TUBE
R. F. Lucy, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 162/165.

. . . for a superheterodyne receiver . . . for the detection of beats in the 2-4Gc region. This phototube incorporates an image dissector with a traveling-wave tube helix structure. It can be used to search an image field by electronic scanning for optical beats. . . .

OPTICAL HETERODYNING WITH NONCRITICAL ANGULAR ALIGNMENT (Correspondence)
W. S. Read, et al., Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1787.

. . . heterodyne detection can be obtained by focusing the signal beam to a diffraction limited spot, and superimposing a collimated local oscillator beam on the spot. . . .

A NEW METHOD OF LASER LIGHT DOWN-CONVERSION AND AMPLIFICATION INTO MICROWAVES BY PARAMETRIC AMPLIFIER
S. Saito, et al., In: International Symposium on Space Technology and Science, Tokyo, Japan, Aug. 27-31, 1962, 4th, Proceedings, Edited by Tamiya Nomura, Tokyo, Japan and Rutland, Vt., Japan Publications Trading Co., 1963, p. 638/639, A64-15046.

. . . parametric amplifier with a glass sealed parametric diode. Two frequency-components of ruby laser-light are mixed in a parametric diode, and their beat frequency component, about 4,000 Mc in the present case, is amplified by the same low noise parametric amplifier. . . .

THE GENERATION OF MILLIMETER WAVES IN RUBY BY OPTICAL PUMPING (Translation)
G. M. Zverev, et al., Soviet Physics—JETP, vol. 17, Oct. 1963, p. 952/954, A63-24193.

. . . in the range 35-50 x 10^9 cps, using ruby cooled to liquid nitrogen temperature. . . . The microwave radiation is found to appear in "spikes" on the oscilloscope screen. The frequency of the spikes increases when the energy of the laser pulse increases. The principal features of the operation of a quantum paramagnetic amplifier with optical pumping are briefly described in terms of an analysis of the kinetic equations for a system of three energy levels . . .

Related Publications:

PHOTO-MIXING EXPERIMENTS AT X BAND (Correspondence)
K. D. Gilbert, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1148

Recently we have described how a miniature 1P42 RCA phototube can be used to detect at S band the optical mixing of axial modes of a ruby laser. The purpose of the present communication is to show that the operation of this device can be extended to X band. . . .

Section 3B.25

3B.250: Transmitting Techniques at Millimeter Waves

Included: Harmonic generators; Varactor multipliers; Fabry-Perot electro-optic modulator; Deflection modulation.

Not Included: Antennas.

Cross References: Millimeter wave generators (Sect. 3B.23 and 3B.24).

Principal Publications:

FREQUENCY SEPARATION AND GENERATION OF ENERGY AT MILLIMETER AND SUBMILLIMETER WAVELENGTHS
E. K. Damon, et al., Antenna Lab., Ohio State U. Research Foundation, Columbus, Rept. on Study of Electromagnetic Radiation, Rept. no. 1073-9, 1 Sept. 1961, 33 p., AD 267 096.

. . . Harmonic generation using nonlinear semiconductor devices as multiplying elements is reviewed. . .

HARMONIC GENERATION AT MILLIMETER WAVELENGTHS
R. G. Pecina, Rutgers U., Coll. of Engineering, New Brunswick, N.J., Final technical rept., 1 Feb. 1961-31 Aug. 1961, Oct. 1961, 115 p., AD 267 553.

. . . methods of generating millimeter and submillimeter wavelength radiation by means of nonlinear harmonic generators. Generators in which the nonlinearity derives from a bulk property such as a nonlinear permittivity or permeability are of primary interest, because of their potential for operation at high power levels. The dependence . . . upon an applied dc electric bias field over the frequency range from 3.0 to 9.5 kmc was determined. Bias fields of 0, 5 and 10 kv/cm were employed. . . . The complete design of the experimental apparatus is given and the limitations of the measuring technique are evaluated.

THE REFLEX KLYSTRON AS AN AMPLIFIER AT 73 kMc (Correspondence)
D. M. Makurat, et al., Proc. IRE, vol. 50, Feb. 1962, p. 210/211.

THE UBITRON AS A HIGH-POWER MILLIMETER WAVE AMPLIFIER
R. M. Phillips, Proc. Nat Aerospace Electronics Conf., vol. 10, May 1962, p. 13/16.

. . . one can expect to obtain the same order of magnitude of power at 100 kmc from a Ubitron as one would obtain at 10 kms from a conventional TWT.

SOLID STATE MODULATION AT MILLIMETER WAVELENGTHS
J. M. Ruddy, Jr., Microwave Research Inst., Polytechnic Inst. of Brooklyn, N.Y., Rept. no. PIBMRI-1030-62, Oct. 1962, 43 p., incl. illus., 12 refs., AD 294 803.

. . . design. . . . of a semiconductor microwave variable attenuator or audio modulator for use in the 26.0 - 40.0 kmc frequency range. Two devices, the Hall effect and the p-i-n modulator, were developed and tested. . . .

DEFLECTION MODULATION AND MILLIMETER WAVES
J. R. Baird, Electrical Engineering Research Lab., U. of Illinois, Urbana, ASD TDR 63 482, 15 April 1963, 95 p., AD 414 948.

. . . The results of the analysis indicate that a relatively simple device could produce a pulsed output power of perhaps a kilowatt at a wavelength of one millimeter.

MODULATION OF A MILLIMETER WAVE REFLEX KLYSTRON BY NOISE (Correspondence)
A. L. Brault, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 243/244.

Because of high-noise figures and low sensitivities of amplifiers and receivers at M band (50-75 kMc), a standard gas discharge noise source is usually unusable. . . . promising results . . . modulation of a millimeter wave reflex klystron by a lower frequency noise source. . . .

EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSISTORS
J. J. Gallagher, et al., Martin Marietta Corp., Orlando, Fla., Quarterly progress rept. no. 4, 1 April-1 July 1963, Rept. no. OR3408, Oct. 1963, p. 79, AD 421 444.

The assembled molecular beam apparatus is described, and calculations are presented on the anticipated beam deflections in a "flop-out" arrangement. . . . Spectroscopic investigations of hydrogen sulfide are discussed. . . .

THE FABRY-PEROT ELECTRO-OPTIC MODULATOR
E. I. Gordon, et al., Bell Syst. Tech. J., vol. 42, no. 1, Jan. 1963, p. 155/179.

. . . It is shown that the correct choice of the spatial variation of the microwave modulating field is essential to achieve efficient modulation and the choice is equivalent to matching the phase velocities of the microwaves and the light. . . . Calculations indicate that bandwidths of several hundred megacycles, centered at any microwave frequency, can be obtained with the expenditure of several watts of modulating power.

ELECTRONICS RESEARCH PROGRAM. INVESTIGATION OF MILLIMETER-WAVE MODULATION AND SIGNAL PROCESSING TECHNIQUES
L. A. Hoffman, et al., Aerospace Corp., Los Angeles, Calif., Semiannual technical rept., 1 Jan.-30 June 1963, Rept. no. TDR169 3250 45TR1, SSD TDR63 258, 31 Oct. 1963, 23 p., AD 424 014.

. . . determine the feasibility of millimeter-wave communication systems in the region between 10 mm (30 Gc) and 1 mm (300 Gc). Initial effort . . . low-noise receiver front-ends and stable millimeter-wave length reference sources . . . use of a phase-locked klystron system. . . .

FREQUENCY MULTIPLIER
J. J. Taub, et al., Airborne Instruments Lab., Inc., Deer Park, N.Y., Quarterly progress rept. no. 2, 1 Oct.-31 Dec. 1963, 31 Dec. 1963, 36 p., AD 433 798.

. . . Experimental results on the 10.65 to 21.3 Gc doubler and the 25 to 50 Gc doubler are also given.

A PROPOSED METHOD FOR IMPROVING THE PASSBAND CHARACTERISTICS OF THE PERIODIC INTERFEROMETRIC MODULATOR
R. A. Williams, Ohio State U., Research Foundation, Antenna Lab., Columbus, Rept. 1093-15, 1 June 1963, 17 p., 3 refs., N63-18861.

. . . the response curve of an interferometric modulator may be improved by using multiple-correlation techniques . . .

V-BAND HARMONIC GENERATOR DEVELOPMENT PROGRAM
Sylvania Electric Products, Inc., Buffalo, N.Y., Final rept., Rept. no. A103 004 5 0 56, 3 Dec. 1963, 43 p., AD 432 665.

. . . to develop and fabricate an all-solid-state V-band harmonic generator having a cw power output of 3 mw at 68 Gc.

Section 3B.26
Millimeter Wave Receiving Techniques

3B.260: Millimeter Wave Receivers

Included: Low noise amplifiers at millimeter waves; Superheterodyne recievers above 30 Gc/s; Bolometer receivers; Ferrite devices in millimeter wave receiving systems.

Not Included: Theory of low noise reception.

Cross References: Parametric low noise amplifiers (3B.262); Masers in millimeter wave range (3B.263); Converters and mixers (3B.264).

Principal Publications:

A 2 MILLIMETER SUPERHETERODYNE RECEIVER USING A HIGH INTERMEDIATE FREQUENCY
G. R. Valenzuela, Radiation Lab., Johns Hopkins U., Baltimore, Md., Tech. rept. AF-88, May 1961, p. 18, AD 257 436.

. . . using fourth harmonic mixing with a first intermediate frequency of 420 mc. The receiver noise figure, the harmonic mixer noise temperature and harmonic mixer conversion loss were experimentally obtained for first intermediate frequencies of 30, 320, and 500 mc . . . An improvement of receiver noise figure of about 3 db can be obtained by applying a forward dc bias to the harmonic mixer.

LOW NOISE AMPLIFIERS FOR CENTIMETRE AND MILLIMETRE WAVES (In German)
H. H. Klinger, Elektron, Rundschau, vol. 16, no. 7, July 1962, p. 293/296.

. . . Various kinds of microwave amplifiers are mentioned and solid state masers are more fully described. . . .

STUDY AND INVESTIGATION OF MILLIMETER AND SUB-MILLIMETER RECEIVER TECHNIQUES
Electrical Engineering Research Lab., U. of Illinois, Urbana., Technical documentary rept. no. 1, 1 March 1961 - 28 Feb. 1962, RADC 62-313, 1 June 1962, p. 43, incl. illus., table, 32 refs., AD 284 905.

. . . usable in the millimeter-infared region. . . . analysis and evaluation of pyroelectric effect detectors . . . Hall effect devices, photo-detection schemes, electron heating in intrinsic semiconductors, and superconducting devices. A goubau beam type waveguide with a design frequency of 75 kmc was constructed for use in evaluating detection schemes. . . . (See also AD 284 562.)

STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES
P. D. Coleman, et al., Illinois, U. Electrical Engineering Research Lab., Urbana, Final Report, March 1, 1961 - Feb. 28, 1963, RADC-TDR-63-170, March 29, 1963, 41 p., 12 refs., N63-18191.

. . . development of video detection techniques . . . A pyroelectric detector . . . has been developed and tested in microwave systems at wavelengths of 8.15 mm, 4.10 mm, and 2.14 mm. The minimum detectable power with the present configuration of 8 μ watts at the longer wavelengths, and between 20 and 200 μ watts at 2.14 mm. . . .

STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES
J. E. Degenford, et al., Illinois U., Urbana Electrical Engineering Research Lab., Griffiss AFB, N. Y. Electronic Warfare Lab., Quarterly Report No. 2, RADC-TDR-63-458, Nov. 1963, 24 p., refs., AD 425 356, N64-12591.

. . . development of video detection techniques which are appropriate for the millimeter and submillimeter range of the spectrum. The pyroelectric detector has been successfully used to detect radiation at a wave-length of 0.845 mm . . .

FERRITE DEVICES FOR RECEIVING SYSTEMS
V. E. Dunn, Melabs, Palo Alto, Calif., Final rept., 15 Feb. 1962-14 June 1963, 14 June 1963, 142 p., AD 431 312.

. . . isolators consist of dielectric loaded circumferentially magnetized ferrite rings mounted concentrically in the circular guide. Experimental results are presented for isolators operating in the 33 to 37 Gc band. . . . nonreciprocal phase shifters consisted of half-round ferrite rings with an externally applied biasing field. Compact transducers from circular to half-round guide were made with 3db multi-hole couplers and 90 degree phase shifters.

TECHNIQUES FOR SUPERHETERODYNE RECEIVERS ABOVE 100 GIGACYCLES
R. F. Packard (editor, Electronic Communications, Inc., Timonium, Md., Washington, NASA, Feb. 1964, 68 p., refs., N64-14937, N63-20195.

. . . receivers of the harmonic-mixing broad intermediate-frequency-band type for use as radiometers . . . A novel bolometer of ferroelectric material for absolute power measurements at millimeter wavelengths is described . . . Experimental results with ferrite Faraday rotators at 2 and 4 mm are given . . . resonator techniques are reviewed, and antennas for millimeter radiometers are compared.

STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES
M. D. Sirkis, Electrical Engineering Research Lab., U. of Illinois, Urbana, Quarterly rept. no. 3, 1 Sept. - 31 Nov. 1963, RADC TDR 64 28, Feb. 1964, 16 p., AD 433 121.

. . . development of video detection techniques . . . tests of the pyroelectric effect detector. . . . capable of detecting a 104 micro watt signal at a wavelength of 0.845 mm. . . .

STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES
Electrical Engineering Research Lab., U. of Illinois, Urbana, Quarterly rept. no. 1, 1 March - 31 May 1963, RADC TDR63 365, Aug. 1963, 25 p., AD 419 448, N63-22406. (See also AD 298 725 and AD 409 462.)

RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVE LENGTHS
Ohio State U. Research Foundation, Columbus Antenna Lab., Rept. 1093-19, Semi-annual Report, 1 Sept. 1963 - 29 Feb. 1964, 1 March 1964, 17 p., refs., N64-19958.

. . . to investigate various detection, generation, and receiver techniques, both conventional and nonconventional, in the millimeter and submillimeter wavelength regions. Most of the effort has been directed toward the development of a submillimeter radiometer . . .

Related Publications:

ELECTRONICS RESEARCH PROGRAM. INVESTIGATION OF MILLIMETER-WAVE MODULATION AND SIGNAL PROCESSING TECHNIQUES
L. A. Hoffman, et al., Aerospace Corp., Los Angeles, Calif., Semiannual technical rept., 1 Jan. - 30 June 1963, Rept. no. TDR169 3250 45TR1, SSD TDR63 258, 31 Oct. 1963, 23 p., AD 424 014.

. . . determine the feasibility of millimeter-wave communication systems in the region between 10 mm (30 Gc) and 1 mm (300 Gc). Initial effort . . . low-noise reciever front-ends and stable millimeter-wave length reference sources . . . use of a phase-locked klystron system. . . .

3B.262: Parametric Amplifiers at Millimeter Waves

Included: Millimeter ferromagnetic type parametric amplifiers.

Not Included: General Theory of parametric amplifiers.

Cross References: Masers in the millimeter range (3B.263).

Principal Publications:

DEVELOPMENT OF A MILLIMETER LOW-NOISE TRAVELING-WAVE AMPLIFIER
E. W. Kinaman, Watkins-Johnson Co., Palo Alto, Calif., Quarterly rept. no. 4, 1 Sept. - 1 Dec. 1961, 17 p., AD 271 054.

. . . The first tube was fabricated and is in test.

RESEARCH ON MILLIMETER FERROMAGNETIC TYPE PARAMETRIC AMPLIFIER
R. A. Moore, et al., Westinghouse Electric Corp., Baltimore, Md., Rept. no. 4, (Final), Feb. 1961 - Feb. 1962, 32 p., incl. illus., AD 274 769.

. . . modified semistatic amplifier . . . frequency range of 5 to 12 kmc . . .

RESEARCH ON MILLIMETER FERROMAGNETIC TYPE PARAMETRIC AMPLIFIER
R. A. Moore, et al., Westinghouse Electric Corp., Baltimore, Md., Quarterly progress rept. no. 2, 1 May - 31 July 1962, Rept. no. 407A2; rept. no. 6, 31 July 1962, 34 p., incl. illus., AD 286 179, AD 295 093.

The dispersion was measured on a resonant rod section across the narrow dimension of the waveguide. . . . A cavity was constructed to resonate at 69.1 kmc, corresponding to the frequency of the pump source now available. The frequency range for which reliable linewidth measurements can be taken was extended well into the region for which propagation effects are significant. The extension was achieved by combining the resonant reaction techniques with a method for varying the degree of coupling. . . .

A 54 Gc PARAMETRIC AMPLIFIER AND DOUBLER (Correspondence)
B. C. DeLoach, Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1153,

Parametric amplifiers have previously been reported at 17.15, 30.0, and 35.5 Gc. This communication reports preliminary operating information on a 54 Gc quasi-degenerate parametric amplifier pumped at 108 Gc, and a 54 Gc doubler. . . .

DEVELOPMENT OF A LOW-NOISE MILLIMETER-WAVE PARAMETRIC AMPLIFIER
J. Kliphuis, Technical Research Group, Syosset, N. Y., Quarterly progress rept. no. 1, 1 July - 1 Oct. 1963, Nov. 1963, 22 p., AD 424 114, AD 434 062.

. . . theoretical analysis shows the required amplifier gain-bandwidth product and noise temperature can be obtained with a diode having a figure of merit of 100 Gc, provided (1) the idler frequency is below the signal frequency and (2) the diode is cooled to liquid helium temperature. Epitaxial gallium-arsenide varactor diodes . . . have been developed . . . for use in 90-Gc waveguide. . . .

RESEARCH ON MILLIMETER FERROMAGNETIC TYPE PARAMETRIC AMPLIFIER
R. A. Moore, et al., Westinghouse Electric Corp., Baltimore, Md., Quarterly progress rept. no. 6, 1 May - 31 July 1963., Rept. no. 10, 407A6, 31 July 1963, 1 v., AD 419 974.

. . . effort . . . toward finding a dielectric with suitably low loss characteristics for construction of four-millimeter resonant structures. . . . (See also AD 413 554, AD 428 561.)

3B.263: Millimeter Maser Devices

Included: Inframillimeter masers; Submillimeter masers; Maser material and techniques at millimeter waves; TWM (traveling wave masers) at millimeter waves; Four level Ku-band maser; No-field powder maser.

Not Included: Theory of masers in general.

Cross References: Parametric amplifiers at millimeter waves (3B.262).

Principal Publications:

MILLIMETER-WAVE-MASER RESEARCH
G. Birnbaum, et al., Hughes Research Lab., Malibu, Calif., Quarterly rept. no. 2, 1 Oct.-31 Dec. 1961, 31 Dec. 1961, 35 p., incl. illus., table, 2 refs., AD 275 272.

. . . use of the ruby laser as an optical pump . . . The growth of single crystals of chromium-doped yttria and other refractory crystals for millimeter maser applications is continuing. . . . available spectroscopic data on emerald have been analyzed to obtain the characteristics of several modes of maser operation at 35 kmc. A theoretical study of the propagation of a pulse of very intense radiation in an absorbing medium has been initiated.

MASER OSCILLATION OBSERVED FROM HCN MASER AT 88.6 kMc
D. Marcuse, et al., Proc. IRE, vol. 49, Nov. 1961, p. 1706/1707.

ADIABATIC RAPID PASSAGE IN RUBY AT 8 mm WAVELENGTHS
J. S. Thorp, et al., J. Electronics and Control, vol. 10, no. 1, Jan. 1961, p. 13/24.

. . . Performance data are given on a two-level ruby maser operated both as a pulsed amplifier and as an oscillator at these wavelengths. When amplifying, values of gain and bandwidth of up to about 15 dB and 10 Mc/s at 1.4°K were obtained, giving root gain-bandwidth products of up to about 50 Mc/s. . . .

EXTREMELY HIGH FREQUENCY MASER AMPLIFIER STUDY PROGRAM
R. L. Bell, et al., Varian Associates, Palo Alto, Calif., Interim engineering rept. no. 1, 15 June-15 Sept. 1962, 15 Sept. 1962, 1 v., incl. illus., 33 refs., AD 286 164.

Research concerns the development of extremely high frequency maser amplifiers for operation above 100 kmc. The application to submillimeter maser technique of large spin magnetic moments characteristic of electrons and holes in some semiconductors and semimetals is described. . . . A pumping technique is described which utilizes tunneling between the magnetic levels of the valence and conduction bands in InSb. . . .

EXTREMELY HIGH FREQUENCY MASER AMPLIFIER STUDY PROGRAM
R. L. Bell, et al., Varian Associates, Palo Alto, Calif., Interim engineering rept. no. 2, 16 Sept.-15 Dec. 1962, Rept. no. 301-2Q, 15 Dec. 1962, 14 p., incl. illus., 18 refs., AD 294 719.

The application of magnetic moment anomalies of carriers in semiconductors to submillimeter maser technology is investigated. . . . measurements at low temperatures and high magnetic fields . . . InSb, the first material to be investigated. . . .

MILLIMETER-WAVE-MASER RESEARCH
G. Birnbaum, et al., Hughes Research Labs., Malibu, Calif., Quarterly rept. no. 3, 1 Jan.-31 March 1962, 31 March 1962, 23 p., incl. illus., AD 275 753.

DEVELOPMENT OF MILLIMETER WAVE MASER
W. E. Hughes, et al., Westinghouse Electric Corp., Baltimore, Md., Quarterly progress rept. no. 2, 1 Sept.-30 Nov. 1962, Rept. no. 1109B, 30 Nov. 1962, 33 p., AD 298 930, AD 293 840.

MASER OPERATION AT 96 kMc WITH PUMP AT 65 kMc (Correspondence)
W. E. Hughes, Proc. IRE, vol. 50, no. 7, July 1962, p. 1691.

STIMULATED EMISSION IN THE SUB-MILLIMETER REGION
R.J. Strain, et al., Illinois U., Urbana, 1962, 21 p., AD 408 391.

. . . experiment used to observe the transitions is an optical pumping experiment, because scattered light is used as an indicator of microwave activity. . . .

MICROWAVE AND OPTICAL MASERS FOR MM WAVES
A. Akselrad, et al., David Sarnoff Research Center, Princeton, N. J., Rept. no. 4, Final, 1 Nov. 1962-31 Oct. 1963, 20 Dec. 1963, 44 p., AD 432 058.

. . . study of far-infrared maser materials . . . Two gas maser cells were constructed suitable for operation in the 3-micron to 300 micron range. . . .

TUNABLE MILLIMETER TRAVELING-WAVE MASER AND 8-MM MASER-RADIOMETER SYSTEM
F. Arams, et al., Airborne Instruments Lab., Inc., Deer Park, N.Y., Final rept., part 1, Rept. no. 8298 1, April 1963, 1 v., AD 420 126.

. . . operates over an extremely wide tuning range (5 Gc), and has gains of 20 db and in-stantaneous bandwidth of 75 Mc. A preliminary noise figure measurement has yielded an over-all maser-radiometer system noise temperature of 130 K (1.6 db). The noise temperature of the maser is near 20 K . . .

MASERS AND MILLIMETER WAVES
F. S. Barnes, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 115/119.

. . . characteristics of a number of different kinds of masers are reviewed to estimate their usefulness in the region between one and a tenth millimeter. . . . the noise characteristics of maser amplifiers are briefly reviewed for this region of the spectrum.

MILLIMETER WAVE MASERS
J. C. Clark, et al., Utah U., Microwave Devices Lab., Salt Lake City, In its Micro-wave Devices Lab., Consolidated Quarterly Rept., March 31, 1963, p. 48/50, 4 refs., N63-18711.

Materials suitable for use in solid state masers at millimeter wave length are investi-gated . . . a solid state maser using the cyclotron resonance levels and impurity doping levels in semiconductors.

OPTICAL PUMPING OF MICROWAVE MASERS
H. Hsu, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 185/189.

. . . It is shown that optical pumping appears to be promising for achieving low noise maser action at very high frequencies and at elevated temperatures. . . .

DEVELOPMENT OF A MILLIMETER WAVE MASER
W. E. Hughes, et al., Westinghouse Defense and Space Center, Baltimore, Md., Final rept., Rept. no. 4, 1109D, 1 Jan. 1964, 129 p., AD 437 258, AD 408 095.

70-Gc MASER (Correspondence)
W. E. Hughes, et al., Proc. IEEE, vol. 51, no. 5, May 1963, p. 856

. . . has been operated . . . with pump power supplied at a frequency of 118 Gc. . . .

DEVELOPMENT OF MILLIMETER AND SUB-MILLIMETER MASER DEVICES
W. E. Hughes, Westinghouse Electric Corp., Baltimore, Md., Interim technical rept. no. 1, 1 Feb.-31 May 1963, 20 p., AD 406 313, AD 420 560, AD 432 597.

. . . experiments at frequencies near 140 gc . . . To date, only the simple 3-level-type maser has been investigated, but analysis of the more complicated 5-level maser will be attempted.

MICROWAVE AND OPTICAL MASERS FOR MM WAVES
Z. J. Kiss, David Sarnoff Research Center, Princeton, N. J., Quarterly rept. no. 2, 1 Feb.-30 April 1963, 30 April 1963, 15 p., AD 414 703, AD 407 549.

Instrumentation for the study of possible far infrared (5 micron - 1000 micron) coherent radiation generators was continued. . . .

A NO-FIELD POWDER MASER
A. W. Nagy, et al., Proc. IEEE, vol. 51, no. 7, July 1963, p. 1037.

The first no-field operation of maser using a monocrystal iron doped sapphire cavity was recently described. Here we report inversion, with no magnetic field, in a powdered sample of this paramagnetic at 4.2^{o}K. . . .

FOUR-LEVEL KU-BAND MASER (Correspondence)
E. J. Schimitschek, et al., Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 363/364.

A four-level push-pull maser using a reflec-tion-type cavity has been built and operated at 15.4 kMc . . .

NONCONFOCAL MULTIMODE RESONATORS FOR MASERS
R. F. Soohoo, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 70/76.

MASER MATERIALS AND TECHNIQUES
J. C. Walling, Mullard Ltd. (Gt. Brit.), CVD Annual rept., Dec. 1962-Dec. 1963, Dec. 1963, 1v., AD 430 969.

. . . attempts to obtain inversion at Q-band using an O-band pump are presented . . . theoretical study of electric loaded slow wave structures such as are used in Travelling Wave Masers.

SUBMILLIMETER MASER INVESTIGATIONS WITH RUBY
G. K. Wessel, Syracuse U., N. Y., Technical rept., 1 June 1962 - 31 Dec. 1963, 48 p., AD 429 381.

Related Publications:

EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS
J. J. Gallagher, et al., Martin Marietta Corp., Orlando, Fla., Quarterly progress rept. no. 4, 1 April-1 July 1963, Rept. no. OR3408, Oct. 1963, 79 p., AD 421 444.

The assembled molecular beam apparatus is described, and calculations are presented on the anticipated beam deflections in a "flop-out" arrangement. . . . Spectroscopic investigations of hydrogen sulfide are discussed. . . .

INVESTIGATION OF RUBY OPTICAL MASER CHARACTERISTICS USING MICROWAVE PHOTOTUBES
B. J. McMurtry, Stanford Electronics Labs., Stanford Univ., Calif., 7 Feb. 1963, 20 p., AD 424 371.

. . . application of photoelectric mixing techniques to the study of the ruby laser. . . . extensive experiments are described. . . .

3B.264: Converters and Mixers at Millimeter Waves

Included: Diode type mixers at millimeter waves; TWT mixer; Quantum mixers; Microwave mixing using the thermo-electric effect.

Not Included: Theory of herterodyning units in general.

Cross References: Photo-mixing for microwave generation (3B.240).

Principal Publications:

TRAVELING-WAVE TUBE MIXER PROGRAM
L. Magill, et al., Sperry Gyroscope Co., Great Neck, N. Y., Interim engineering rept. no. 6, 1 Aug-31 Oct. 1962, Rept. no. NA-8210-8283-6, Nov. 1962, 18 p., incl. illus., tables, 1 ref., AD 292 135.

The conclusions of a detailed analysis of mixing millimeter waves in beam-type devices led to the design and construction of a two-helix traveling wave-tube mixer. . . .

DIODE, MILLIMETER WAVE TYPE MIXER (3.2 MM)
R. J. Bauer, et al., Electronic Communications Inc., Timonium, Md., Quarterly progress rept. no. 2, 1 Sept. - 30 Nov. 1963, 30 Dec. 1963, 40 p., AD 433 797.

. . . problems encountered with RF impedance measurement equipment and klystrons. . . . A method is presented for observing the RF rectification characteristic of a diode while it is being formed. . . .

RESEARCH STUDIES OF QUANTUM DETECTORS AND MIXERS
D. Blattner, et al., Radio Corp. of America, Harrison, N. J., Quarterly progress rept. no. 6, 1 Oct.-31 Dec. 1963, 31 Dec. 1963, 29 p., AD 432 228.

Theoretical and experimental studies of the effect of velocity dispersion in transmission-secondary-electron-multiplication (TSEM) on frequency response of a TSEM microwave phototube were concluded. . . .

MICROWAVE DETECTION AND MIXING USING THE THERMO-ELECTRIC EFFECT OF HOT CARRIERS IN SEMICONDUCTORS
R. I. Harrison, et al., Applied Physics Letters, vol. 3, Nov. 1, 1963, p. 153/154, A64-13352.

Experimental investigation in which laser action was observed in a chlorine gaseous discharge. The laser used consisted of a 1.75-m long, 6-mm diam. quartz tube with Brewster-angle windows, with the optical cavity being formed by a set of one fully and one partially silvered hemispherical mirrors. . . .

TRAVELING-WAVE-TUBE MIXER
L. Magill, Sperry Gyroscope Co., Great Neck, N. Y., Final rept., 1 April 1961-31 May 1963, Rept. no. NA8220 8366, RTD TDR 63 4217, March 1964, 37 p., AD 437 812.

. . . a two-helix traveling-wave-tube mixer capable of operation from 50 to 60 Gc. . . . technical difficulty arose from the use of molybdenum in the tube shell and support structure. . . . All brazing efforts failed, so a device was constructed and sealed by means of an epoxy adhesive.

AN EXPERIMENTAL Ka-BAND MIXER
F. H. Thompson, Naval Research Lab., Washington, D. C., NRL 5934, 20 May 1963, 6 p., AD 407 807.

A K-band to X-band converter has been developed and placed in operation at a field site . . . The measured parameters of bandwidth and conversion loss were 200 Mc and 12 to 15 db, respectively. A minimum detectable signal of -72 dbm was measured using an X-band traveling-wave tube as the first i-f amplifier.

3B.265: Detectors and Demodulators at Millimeter Waves

Included: Three-level maser detector; Photoelectric millimeter wave detector; Traveling wave phototube (TWP) as microwave detector; Pyroelectric effect detector; Low-noise millimeter detector; Backward diodes as millimeter wave detector; Crystal detectors.

Not Included: Detection theory (2).

Cross References: Photomixing for microwave generation (3B.240).

Principal Publications:

THREE-LEVEL MASER DETECTOR FOR ULTRA-MICROWAVES
K. Shimoda, J. Phys. Soc. Japan, vol. 14, no. 7, July 1959, p. 966.

. . . incidence of sub-millimetre waves would change the population in one level that affects the absorption of centimetre waves. . . . could be used as a detector for the sub-millimetre waves. . . .

CRYSTAL DETECTORS TO COVER THE FREQUENCY BAND 26-40 Gc/s.
H. V. Shurmer, Proc. Instn. Elect. Engrs. Pt. B, vol. 108, no. 42, Nov. 1961. p. 659/665.

PHOTOELECTRIC MILLIMETER WAVE DETECTOR
P. R. Bratt, et al., Raytheon Co., Burlington, Mass., RADC TDC 63 502, Dec. 1963, 43 p., AD 427 092.

. . . application of semiconducting materials to the problem of detection of electromagnetic radiation in the millimeter and submillimeter wavelength range. . . involves the use of the internal photoelectric effect (i.e., photoconductivity) in certain semiconductor materials at at very low temperatures . . . (See also AD 422 561, AD 408 415).

LOW NOISE MILLIMETER DETECTOR
C. H. Brunquell, Microwave Associates, Inc., Burlington, Mass., Final rept., RADC TDR63 44, 7 Jan. 1963, 112 p., AD 403 139.

. . . basis of the 2-millimeter detector design after preliminary comparison with existing rectangular waveguide detectors at 4-millimeter wavelengths. . . . Results indicate that a 2-mm video detector can be fabricated with a -35 dbm tangential signal sensitivity at 10 uA bias and 1 mc video band width. . . .

BACKWARD DIODES FOR LOW-LEVEL MILLIMETER-WAVE DETECTION
C. A. Burrus, Jr., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 357/362, 20 refs., A64-11525.

DESIGN AND DEVELOPMENT OF A PHOTO-MIXING DEVICE
D. E. Caddes, Sylvania Electric Products, Inc., Mountain View, Calif., Microwave Device Div., Final Report, AFCRL-63 379; 9 Aug. 1963, 76 p., refs., AD 422 961, N64-12676.

A traveling-wave phototube (TWP) has been developed which is capable of photomixing optical signals of differing frequency content and detecting the resultant difference frequency signal (beat) over the 11 to 20 Gc band. This represents the broadest bandwidth presently available in a practical photodetector. An important spectroscopic application of this tube would be in the examination of laser outputs. In addition to its photomixing capability, this TWP is a sensitive detector of amplitude modulation of light over this same broad bandwidth.

PHOTOELECTRIC MILLIMETER WAVE DETECTOR
G. F. Giggey, Raytheon Co., Burlington, Mass., Quarterly rept. no. 3, Feb. 1964, 13 p., AD 436 643.

. . . application of semiconducting materials to the problem of detection of electromagnetic radiation in the millimeter and submillimeter wavelength of range. . . .

BROADBAND CRYSTAL - VIDEO DETECTORS FOR MILLIMETER WAVEGUIDES
C. Heinzman, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 371/395.

Detector mount designs for the bands 33-50 Gc, 50-75 Gc, 60-90 Gc, and 75-110 Gc are discussed. . . .

DETECTION OF MILLIMETRE AND SUB-MILLIMETRE WAVE RADIATION BY FREE CARRIER ABSORPTION IN A SEMICONDUCTOR
M. A. Kinch, et al., Brit. J. Appl. Phys., vol. 14, Oct. 1963, p. 672/676, A63-25080.

. . . The device is based on the observation that radiation absorbed by the free carriers in a semiconductor gives rise to an increase in the carrier temperature and a change of mobility. . . .

THE DETECTION OF SUB-mm RADIATION
E. H. Putley, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1412/1423.

A PYROELECTRIC EFFECT DETECTOR FOR SUBMILLIMETER WAVELENGTHS (Correspondence)
W. H. Steier, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1144.

DETECTOR INVESTIGATION FOR 8-15 AND 100-4000 MICRON REGIONS
R. F. Wallis, et al., Naval Research Lab., Washington, D. C. Summary rept., 1 July 1961 - 30 June 1963, NRL 5996, 29 Aug. 1963, 48 p., AD 419 573.

. . . theoretical and experimental work . . . on photoconductive, long-wavelength detectors, a boron-doped germanium detector . . . For 4-mm-wavelength radiation . . .

Section 3B.28

3B.280: Special Applications of Millimeter Waves

Included: Space radar equipment at millimeter wave lengths; Millimeter wave reconnaissance; Tracking of exhaust plumes; Millimeter radar techniques; Plasma research with millimeter waves.

Cross References: Applications of optronic devices (3B.380); Plasma research (3B.520).

Principal Publications:

MILLIMETER RADIOMETER MEASUREMENT PROGRAM
D. J. Bruno, Army Electronics Research and Development Agency, Ft. Monmouth, N. J., AELRDL TR 23 53, July 1963, 34 p., AD 421 501.

. . . With the information derived from this measurement program, it is now possible to design an airborne radiometer operating at 4.3 millimeters.

MILLIMETER TECHNIQUE EVALUATION OF GUIDANCE DATA ATTENUATION BY EXHAUST PLUMES
A. H. Green, Jr., Army Missile Command, AMC RA RE TR 63 31 Rev., 26 March 1964, 37 p., AD 435 539, N64-18786.

. . . The interaction of a plasma with an electromagnetic wave is related to three essential parameters: (1) the collision frequency of free electrons with neutral particles, (2) the free electron density, and (3) the frequency of the electromagnetic wave. . . .

MILLIMETER WAVES
D. D. King, Electronic Communications, Inc., Timonium, Md., In Md. U. Proc. of the Space Communications Inst. Md. U., College Park, June 23-28, 1963, 1963, p. 78/92, refs., N64-17201.

. . . usefulness of millimeter waves for communications and tracking, from an engineering point of view . . .

RADAR OBSERVATIONS OF THE MOON AT A WAVELENGTH OF 8.6 MILLIMETERS
V. L. Lynn, et al., J. Geophys. Res. vol. 69, Feb. 15, 1964, p. 781/783, A64-14365.

. . . to determine the distribution of radar microwave beam scattering at 8.6 mm wavelength and 12 watts power output. . . . Approximately 85 per cent of the total reflection is the result of rough scattering. . . .

MILLIMETER WAVELENGTH FOCUSED PROBES AND FOCUSED, RESONANT PROBES FOR USE IN STUDYING IONIZED WAKES BEHIND HYPERSONIC VELOCITY PROJECTILES
R. I. Primich, et al., GM Defense Research Lab., Santa Barbara, Calif., Rept. no. TR 63 217C, July 1963, 51 p., AD 413 158.

. . . specific details of 35 and 70 Gc probes are given . . .

MICROWAVE AND LASER TECHNIQUES AS FLIGHT VEHICLE POWER TRANSMISSION SUBSYSTEMS
J. D. Reams, Air Force Aero-Propulsion Lab., Aeronautical Systems Div., Wright-Patterson AFB, Ohio, Final rept., Sept. 1962-May 1963, ASD TDR 63 517, July 1963, 27 p., AD 415 288.

. . . for transmitting flight vehicle power between two points in space. . . . over-all efficiency of lasers must be improved by approximately two orders of magnitude . . .

MILLIMETER RADAR TECHNIQUES FOR STUDYING PLASMA EFFECTS ASSOCIATED WITH HYPERSONIC VELOCITY PROJECTILES
P. E. Robillard, et al., General Motors Corp., Santa Barbara, Calif., Defense Research Labs., TR-63-217B, July 1963, 47 p., 5 refs., Presented at Millimeter and Submillimeter Conf., Orlando, Fla., Jan. 1963, N63-21552.

. . . being used as plasma diagnostic tools to study the ionization immediately behind the bow shock which is associated with a projectile fired at hypersonic velocities into a flight physics range under controlled environmental conditions . . . two radars, which operate at frequencies of 35 and 70 Gc respectively, are described in some detail . . . (See also AD 415 180).

MILLIMETER WAVE WORK
W. V. T. Rusch, et al., JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 135/136.

. . . The objective of the . . . project is to investigate millimeter-wave components and techniques to ascertain the future applicability of this frequency range to space communication and tracking. . . .

RESEARCH AND EXPERIMENTATION ON SPACE APPLICATIONS OF MILLIMETER WAVES
J. Stacey, Aerospace Corp., Los Angeles, Calif., Semiannual tech. note, 1 Jan.-30 June 1963, Rept. no. TDR169 3250 41TN2, SSD TDR 63 294, 5 Feb. 1964, 331 p., AD 434 543.

. . . planning and construction of the Space Radio Systems Facility . . . for studying the utility of systems objectives in the millimeter wavelength region. . . .

MILLIMETER-WAVE WORK
C. T. Stelzried, et al., JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 113/117.

. . . have built a super-heterodyne radiometer and fitted it to a 60-in antenna to make a radio telescope. The radio telescope was used to observe the 90-Gc temperature of the Moon during a recent eclipse; the measurements are discussed. . . .

Section 3B.29

3B.290: Millimeter Wave Measurements

Included: Interferometers in the millimeter range; Submillimeter measurements; Radiometers; Wattmeters; Noise source for millimeter wave lengths; Bolometers; Millimeter spectrometers; Superheterodyne radiometers; Submillimeter interferometers; Fabry-Perot resonators as measurement instrument; Wavemeters.

Not Included: Microwave measurement techniques in general; Frequency standards.

Cross References: Fabry-Perot resonators as modulators (3B.250).

Principal Publications:

MILLIMETER WAVE TRANSITIONS FOR FREQUENCY CONTROL
F. Barnes, et al., Colorado U., Boulder, Quarterly progress rept. 2, 11 July-10 Oct. 1960, 50 p., AD 250 155.

. . . directed toward developing a frequency standard . . .

RESISTIVE-FILM MILLIWATTMETERS FOR THE FREQUENCY BANDS 8.2-12.4Gc/s. 12.4-18Gc/s and 26.5-40Gc/s.
I. Lemco, Proc. Instn. Elect. Engrs., Pt. B, vol. 107, no. 35, Sept. 1960, p. 427/430.

SOME CONSIDERATIONS FOR RADIOMETER DESIGN AND APPLICATION AT 70 GIGACYCLES
L. Ball, Antenna Lab., Ohio State U. Research Foundation, Columbus, Rept. no. 898 16, 1 Oct. 1961, 61 p., AD 417 866.

. . . the design of a radiometer can be simplified by treating the antenna design separately from the rest of the system . . .

EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS
J. J. Gallagher, et al., Martin Co., Orlando, Fla., Quaterly prog. rept. 1, 1 July-30 Sept. 1961, 27 Oct. 1961, 26 p., AD 267 850.

. . . excitation and detection techniques for molecular millimeter wave transitions which can be used to develop a frequency standard operating the region of 200-300 kmc.

RADIOMETER INSTRUMENTATION FOR THE 1 TO 2 MILLIMETER WAVELENGTH REGION
M. Cohn, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 537/541.

. . . a high-sensitivity receiver of special design which is frequently used to detect radiant energy over a relatively broad band.

AN OSCILLATORY TORQUE-OPERATED WATTMETER FOR THE 8mm WAVEBAND
H. A. French, et al., Proc. Instn. Elec. Engrs, Pt. B, vol. 109, no. 48, Nov. 1962, p. 511/514.

MULTI-CHANNEL MILLIMETER RADIOMETER FOR DEEP SPACE
E. W. Richter, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 537/541.

A HIGH ACCURACY TECHNIQUE FOR THE MEASUREMENT OF MICROWAVE FREQUENCY AND PHASE MODULATION
S. A. Rosen, IRE Internat. Conv. Rec., Pt. 3, vol. 10, March 1962, p. 206/213.

. . . based on the use of a ferrite single sideband modulator . . .

RESEARCH IN MICROWAVE SPECTROSCOPY
J. Sheridan, et al., Birmingham U. (Gt. Brit.) Jan. 1962, 28 p., incl. illus., tables, 6 refs., AD 273 614.

. . . Refinements in methods of generation and detection of microwave harmonics at wavelengths down to the 1-2 mm region are discussed.

CARBON MONOXIDE TIME STANDARD
National Co., Inc., Malden, Mass., Final rept., 26 April 1960-31 Dec. 1961, RADC TDR 62-257, April 1962, 1v., incl. illus., refs., AD 282 246.

. . . A stabilized source of excitation radiation of frequency 115 kmc has been constructed and tested. . . .

MILLIMETER WAVE TRANSITIONS FOR FREQUENCY CONTROL. SURFACE IONIZATION OF LITHIUM FLUORIDE AND THALLIUM ON TUNGSTEN, RHENIUM, AND PLATINUM SURFACES
S. G. Andresen, Colorado U., Boulder, Special technical progress rept. no. 1 for March 1963, AD 400 494.

SUBMILLIMETER RADIOMETRY
J. W. Battles, et al., Naval Ordnance Lab., Corona, Calif., NAVWEPS 8169, 1 Nov. 1963, 30 p., AD 424 017.

. . . discusses some of the problems involved in defining the parameters of a submillimeter radio meter . . . a short survey is given of millimeter and submillimeter wave components . . .

MICROWAVE TYPE BOLOMETER FOR SUBMILLIMETER WAVE MEASUREMENTS
J. F. Byrne, et al., IEEE Trans. Microwave Theory and Techniques, vol. MTT-11, Sept. 1963, p. 379/384, A64-11528.

HIGH-SENSITIVITY 100-TO 300-Gc RADIOMETERS
M. Cohn, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1227/1232.

A SUBMILLIMETER MEASUREMENT SYSTEM USING A HARMONIC MIXING SUPERHETERODYNE RECEIVER
J. M. Cotton, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 385/389, A64-11529.

NOISE SOURCE FOR MILLIMETER WAVELENGTH
A. M. Eklund, Bomac Labs., Inc., Beverly, Mass., Quarterly rept. no. 1, 1 July-1 Oct. 1963, 1 Oct. 1963, 20 p., AD 428 734.

. . . initial design considerations of the standard hot load source and the gas tube noise source . . .

MEASUREMENTS AT MILLIMETER AND SUBMULLIMETER WAVELENGTHS - A PROGRESS REVIEW 1960-1963
R. G. Fellers, IEEE Trans. Instrum. Measurement, vol. IM-12, Dec. 1963, p. 139/141, 28 refs., A64-17348.

EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS
J. J. Gallagher, et al., Martin-Marietta Corp., Orlando, Fla, Quarterly progress rept. no. 3, 1 Jan. - 1 April 1963, 25 p., AD 409 854.

. . . A Fabry-Perot interferometer has shown high sensitivity as a millimeter spectrometer.

WAVEMETERS FOR MILLIMETER WAVELENGTHS
G. R. Gathers, California U., Berkeley, 1963, 6 p., AD 415 633.

MILLIMETER SPECTROMETER USING A FABRY-PEROT INTERFEROMETER
M. Lichtenstein, et al., Rev. Sci. Instrum. vol. 34, Aug. 1963, p. 843/846, 10 refs., A63-21500.

Analysis of microwave absorption of the hydrogen sulfide molecule. . . . A comparison is given between lines observed in the interferometer and those observed in standard waveguide absorption cells.

NEW TECHNIQUE FOR MICROWAVE RADIOMETRY
M. W. Long, et al., Georgia Inst. of Tech., Engineering Experiment Station, Atlanta, Technical rept. no. 4, 3 May 1963, 34 p., AD 419 405.

. . . interference modulation technique . . . for tuning over a wide range of frequencies . . . for determining the absolute sensitivity of detectors . . . applicable to wavelengths well into the low millimeter region.

NEW TECHNIQUE FOR MICROWAVE RADIOMETRY
M. W. Long, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 389/397, A64-11530.

RADIOMETRIC MEASUREMENTS AT 8.5-MM WAVELENGTH WITH A 28-FOOT ANTENNA DURING DECEMBER 1962
V. L. Lynn, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, TR330, ESD TDR 63 590, 8 Oct. 1963, 32 p., AD 430 926.

A precisely calibrated 28-foot antenna . . . with a beamwidth of 4.3 ft, has been utilized to observe emission from Venus near inferior conjunction, from the region of Taurus A and from the moon. Simultaneous observations at 12 mm with the same antenna are described in a current report by the Research Laboratory of Electronics (M.I.T.). . . .

SUPERHETERODYNE RADIOMETERS FOR USE AT 70 Gc AND 140 Gc
R. Meredith, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 397/411, 31 refs., A64-11531.

A MEASUREMENT OF BOLOMETER MOUNT EFFICIENCY AT MILLIMETER WAVELENGTHS
R. H. Miller, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 435/436, A64-11540.

THE APPLICATION OF THE FOCUSED FABRY-PEROT RESONATOR TO PLASMA DIAGNOSTICS
R. I. Primich, et al., GM Defense Research Labs., Santa Barbara, Calif., Rept. no. TM63 210, Aug. 1963, AD 417 636.

TUNABLE SUBMILLIMETER INTERFEROMETERS OF THE FABRY-PEROT TYPE
R. Ulrich, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 363/371, 17 refs., A64-11526.

SUPERCONDUCTING BOLOMETERS
W. H. Wells, et al., JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 124/125.

The voltage-current characteristics of the superconducting bolometer reported previously (Ref. *8) have been studied. . . . Theoretically, one expects the e-i curves to be S-shaped with a negative resistance section for low heater power. This has been observed, but with an unexplained, frequency-independent hysteresis.

SPHERICAL MIRROR FABRY-PEROT RESONATORS
R. W. Zimmerer, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 371/379, 26 refs., A64-11527.

MEASUREMENTS AT MILLIMETER AND SUBMILLIMETER WAVELENGTHS
South Carolina U., Columbia, Rept. for 1960-1963, 6 p., AD 418 157.

PROCEEDINGS OF THE SEVENTEENTH ANNUAL FREQUENCY CONTROL SYMPOSIUM 27, 28, 29 MAY 1963, SHELBURNE HOTEL, ATLANTIC CITY, N. J.
Army Electronics Research and Development Agency, Ft. Monmouth, N. J., 1963, 618 p., AD 433 101.

. . . Masers, Millimeter waves, Very high frequency, Stability. . . .

Related Publications:

ANTENNAS FOR MICROWAVE RADIOMETRY
H. W. Cooper, East Coast Conf. Aerosp. Navig. Electronics, vol. 6, no. 5.5, Oct. 1959.

FREE CARRIER ABSORPTION DETECTOR FOR MILLIMETER WAVELENGTHS
H. J. Moody, et al., RCA Victor Co., Ltd. (Canada), Rept. for Feb. 1961 - Sept. 1962, on EHF Feasibility Techniques for Aerospace Communications, Research rept. no. 6-400-8, ASD TDR 62-1092, Oct. 1962, 77 p., incl. illus., table, refs., AD 400 158.

. . . experiments . . . A brief summary of the theoretical background and a possible explanation of some of the results is also given.

THE PRINCIPLES OF THE DOUBLE RESONANCE METHOD APPLIED TO GAS CELL FREQUENCY STANDARDS
M. Arditi, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 190/202.

. . . using optical pumping and optical detection of the O-O hyperfine transition in alkali metal vapors, have been developed with good performances . . .

EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS
J. J. Gallagher, et al., Martin Marietta Corp., Orlando, Fla., Quarterly progress rept. no. 4, 1 April - 1 July 1963, Rept. no. OR3408, Oct. 1963, 79 p., AD 421 444.

. . . Spectroscopic investigations of hydrogen sulfide are discussed. . . .

INSTRUMENTATION AND MEASUREMENTS
R. W. Tucker, et al., Harry Diamond Labs., Washington, D. C., In Natl. Acad. of Sci.-Natl. Res. Council Dielectrics Dig. of Lit. Vol. 26, 1962, 1963, p. 1/6, N64-14183.

An annotated bibliography is presented that includes information on: (1) books on instrumentation (2) measurements below 100 mc-standards, d. c. methods, and a. c. methods; and (3) measurements above 100 mc-resonance methods, waveguide methods, and miscellaneous apparatus and technique

DIVISION 3B.3
OPTICAL DEVICES

This division contains material on components and subsystems for optical communications and optical processing applications; this field is designated "Optronics."

Section 3B.32 gives references to fiber optics and to other interesting new optical techniques, such as the field of non-linear optics. It is followed by a section on optical components.

The section on lasers deals primarily with the praxis of laser technology. Publications with detailed reports on laser physics have not been included, as they number in the hundreds. Every effort has been made, however, to quote publications covering the application of lasers in communications and in related fields of electronics.

Accordingly, the reader will find a rather complete set of references on optical modulators, optical demodulators, optical converters and light amplifiers in sections 3B.35, 3B.36 and 3B.37.

The last section (3B.38) brings an interesting cross section through the many application areas of optronics devices, primarily lasers. In this section one may also find a few non-communications applications listed.

Section 3B.30

3B.300: General References on Optical Devices

Included: Coherent light for power transmission; Optronics in general.

Not Included: Design of optical elements; Photographic devices.

Cross References: Quasi-optic techniques in general (3B.200).

Principal Publications:

A RESEARCH PROGRAM ON THE UTILIZATION OF COHERENT LIGHT
D. J. Blattner, et al., David Sarnoff Research Center, Princeton, N. J., Interim rept. no. 6, 1 Oct.-31 Dec. 1962, 20 Jan. 1963, 28 p., incl. illus., 11 refs., AD 296 145.

A CaF2:Dy2+ optical maser, a cuprous-chloride electro-optic modulator. . . a lead selenide detector were used together in a demonstration of an optical maser communication system carrying an audio channel. . . .

A RESEARCH PROGRAM ON THE UTILIZATION OF COHERENT LIGHT
L. Arons, et al., RCA Labs., Div., Radio Corp. of America, Princeton, N.J., Summary rept., April 1961-March 1963, ASD TDR 63 529, April 1963, 120 p., AD 421 819.

. . . summarizes two years of work on the Utilization of Coherent Light Project. The report is relatively brief; for details the reader is referred to earlier progress reports and to the many published papers relating to work on this contract. . . .

LIGHT AND HEAT SENSING. SIXTH AGARD AVIONICS PANEL MEETING. PARIS, JULY 1962
H. J. Merrill (Editor), Advisory Group for Aeronautical Research and Development, Paris (France), AGARD 71, 1963, 457 p., AD 430 339.

Descriptors: Light, Detection. . . Infrared detectors. . . Ultraviolet radiation. . . Lasers, Fiber optics, Image intensifiers. . .

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia Radiation Lab., New York. Quarterly prog. rept. no. 4, 16 Sept.-15 Dec. 1963, Rept. no. CU12 63, 15 Dec. 1963, 77 p., AD 430 797.

. . . Partial success was achieved in the fabrication of optical double-resonance cells for chemically reactive elements such as calcium. Theoretical studies are continuing on laser quenching of metastable atoms. . . . a model of the Venusian atmosphere was constructed which is consistent with all available data.

MICROWAVE AND LASER TECHNIQUES AS FLIGHT VEHICLE POWER TRANSMISSION SUBSYSTEMS
J. D. Reams, Air Force Aero-Propulsion Lab., Aeronautical Systems Div., Wright Patterson AFB, Ohio. Final rept., Sept. 1962-May 1963, ASD TDR 63 517, July 1963, 27 p., AD 415 288.

. . . feasibility of using microwave techniques and lasers for transmitting flight vehicle power between two points in space. . . . Microwave techniques are not practical. . . The over-all efficiency of lasers must be improved by approximately two orders of magnitude and the cooling requirements drastically reduced before lasers begin to be attractive. . .

THE QUANTUM ELECTRONICS ISSUE
J. R. Singer (Guest Editor), Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 3.

PRINCIPLE OF THE MOLECULAR AMPLIFIER AND GENERATORS OF COHERENT LIGHT
B. M. Yavorskiy, Foreign Tech. Div., Air Force Systems Command, Wright Patterson AFB, Ohio, 1 April 1963, 13 p., 13 refs., Trans. no. FTD-TT-62-1822 from Svstotekhnika, No. 2, p. 1/5, 1962, AD 402 436.

Section 3B.31

3B.310: Theoretical Optronics

Included: Optical coherence; Quantum theory of optical coherence; Granularity of scattered laser light.

Principal Publications:

NOTE ON COHERENCE VS NARROW-BANDEDNESS IN REGENERATIVE OSCILLATORS, MASERS, LASERS, ETC. (Correspondence)
M. J. Golay, Proc. IRE, vol. 49, May 1961, p. 958/959.

DEFINING THE COHERENCE OF A SIGNAL (Correspondence)
R. N. Bracewall, Proc. IRE, vol. 50, Feb. 1962, p. 214.

COMMENT ON COHERENCE (Correspondence)
M. J. Golay, Proc. IRE, vol. 50, Feb. 1962, p. 223.

COHERENCE-TIME AND EFFECTIVE BANDWIDTH OF BLACKBODY RADIATION
C. L. Mehta, Rochester U., N. Y., 20 Nov. 1962, 8 p., AD 413 772.

RECEPTION OF COHERENT WAVES IN RADIO-ELECTRIC AND OPTICAL FORMS (In French)
G. Pircher, Onde Electr., vol. 42, no. 429, Dec. 1962, p. 1063/1068.

. . . description of various basic differences between transmission of information on optical carriers and on radio-electric carriers . . . importance of lateral coherence in the optical form. . . comparison of the noise. . . effect of quantum fluctuations in optics. . . comparison of the powers necessary in radio electricity and in optics.

TIME COHERENCE IN RUBY LASERS (Correspondence)
J. F. Ready, Proc. IRE, vol. 50, no. 7, July 1962, p. 1695/1696.

THE GRANULARITY OF SCATTERED OPTICAL MASER LIGHT (Correspondence)
J. D. Rigden, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2367/2368.

THE SCATTERING AND ABSORPTION OF ELECTROMAGNETIC RADIATION BY MATTER
D. Warner, Jr., Radiation Lab., Johns Hopkins U., Baltimore, Md., Technical rept. no. AF-97, July 1962, 60 p., 8 refs., AD 283 517.

. . . starting from first principles. The electromagnetic field is included in the problem from the beginning and the nature of this field as radiated by different sources is discussed and analyzed. In particular, it is pointed out that the field can exist in quantum states, some of which have classical analogues and some of which do not. A formalism is developed which includes the concept of temperature. The need for treating matter as one system and not as an ensemble of separate systems is pointed out. . . . Such phenomena as the line widths in gas masers, the relaxation times in maser and laser materials, noise in solid state amplifiers and a host of other related problems can be handled by this physically rigorous and unified procedure.

INTERACTIONS OF COHERENT OPTICAL RADIATION WITH SOLIDS
R. Braunstein, et al., RCA Labs., Div. Radio Corp. of America, Princeton, N. J., Semiannual technical summary rept., 1 May 1963-31 Dec. 1963, 31 Dec. 1963, 37 p., AD 431 975.

. . . study of double-photon absorption, harmonic generation in semiconductors, and the frequency tuning of injection lasers by uniaxial stress are reported. . . .

A DISCUSSION OF PARTIAL COHERENCE AS RELATED TO OPTICAL MASERS
W. S. Chang, et al., Antenna Lab., Ohio State U., Research Foundation, Columbus, Rept. no. 1579 2, 1 May 1963, 77 p., AD 407 513.

THE INTERACTION OF LIGHT WITH LIGHT
J. A. Giordmaine, Scientific American, vol. 210, April 1964, p. 38/49, A64-16542.

Discussion of the changes in characteristics of the light from lasers when passing through a transparent crystal. . . .

THE QUANTUM THEORY OF OPTICAL COHERENCE
R. J. Glauber, Lyman Lab. of Physics, Harvard U., Cambridge, Mass., 15 June 1963, 11 p., AD 416 564.

. . . a succession of correlation functions for the complex field strengths is defined. . . A fully coherent field is defined as one whose correlation functions satisfy an infinite succession of stated conditions. . . It is shown, as a result, that coherence does not require monachromaticity. Coherent fields can be generated with arbitrary spectra.

THE QUANTUM THEORY OF OPTICAL COHERENCE
R. J. Glauber, Physical Review, 2nd Series, vol. 130, June 15, 1963, p. 2529/2539, 13 refs., A63-19271.

A SURVEY OF METHODS FOR DYNAMIC SYSTEM IDENTIFICATION AND RESEARCH IN OPTICAL COHERENCE
R. B. Mc Ghee, et al., University of Southern Calif., Engineering Center, Los Angeles, Final Report, March 1963, 89 p., 52 refs., N63-17065, AD 405 815.

. . . first phase of a study of the feasibility of utilizing computers in the determination of mathematical models for dynamic systems are summarized. . . . A new formulation of the general model inference problem, called the "parameter space method," is presented. A detailed study of the theory of optical coherence is conducted to obtain criteria for optimizing optical systems employing coherent sources and amplifiers, such as lasers. . . .

DIFFRACTION AND FOCUSING OF PARTIALLY COHERENT RADIATION BY A CIRCULAR APERTURE
J. G. Meadors, Ohio State U. Research Foundation, Columbus Antenna Lab., Rept. 1579-4, 15 Nov. 1963, 32 p., refs., AD 428 764. N64-15364.

Diffraction patterns of a circular aperature illuminated by partially coherent light can be calculated for several types of correlation functions and radially varying intensities . . .

NUMERICAL COMPUTATION OF PHASE FROM AMPLITUDE AT OPTICAL FREQUENCIES
D. E. Thomas, Bell Syst. Tech. J., vol. 42, no. 3, May 1963, p. 637/679.

. . . presents phase tables for use in determining phase from amplitude or vice versa at optical and higher frequencies. The new tables, combined with tables previously published by the author, are believed to make possible the determination of phase from amplitude or vice versa of any minimum phase function occurring in any area of the physical sciences, and at any place in the frequency spectrum. The phase is determined by a summation process based on Bode's straight-line approximation method. . . .

. . . this relationship is commonly known in the physical science world as the Kramers-Kronig relation. . . .

THE FREQUENCY RESPONSE FUNCTION IN A COHERENT OPTICAL SYSTEM AND ITS FREQUENCY SELECTION CHARACTERISTICS IN TRANSMITTING OPTICAL INFORMATION
T. Wei-han, Emmanuel Coll., Boston, Mass., Research Language Center, Research trans. ETCh63 4, May 1963, 14 p., AD 420 430.

THE ANALYSIS OF LASER OPERATION FROM A MICROWAVE CIRCUIT VIEW POINT
M. R. Wohlers, Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept., July 1963, 15 p., refs., N64-14874.

Related Publications:

THEORY OF COHERENT SYSTEMS
W. M. Brown, et al., IRE Trans. Mil. Electronics, vol. MIL-6, no. 2, April 1962, p. 187/196.

A circuit theory model is derived for coherent radar, communication, sonar and antenna systems. . . .

Section 3B.32

3B.320: Special Optical Techniques

Included: Applications of fiber optics; Pulsed light devices; Flashing light beacon; Non-linear optical techniques; High intensity pulsed beams of coherent light; Beating two optical masers; Thin film tunneluminescence.

Not Included: Theory of fiber optics; Electromagnetic light theory.

Cross References: Optical components (3B.330); Photo mixing for microwave generation (3B.238).

Principal Publications:

FIBER OPTICS YIELDS A NEW SCANNER CONCEPT
R. Day, et al., Control Engng., vol. 8, no. 12, Dec. 1961, p. 101/104.

OPTICAL DIELECTRIC WAVEGUIDES
E. Snitzer, American Optical Co., Southbridge, Mass., Scientific report no. 3, May 1961, 51 p., AD 261 840.

A general survey is given of the properties of small glass fibers acting as dielectric wave-guides in the visible region of the spectrum. . . . Finally, the modes in a Fabry-Perot interferometer of wide plate spacing are discussed as the limiting case of a dielectric waveguide of large cross-section and vanishingly small index difference between core and cladding.

RESEARCH AND DEVELOPMENT OF INFRARED FIBER OPTICS
N. S. Kapany, Optics Technology, Inc., Belmont, Calif. Final rept., April 1961-April 1962, ASD TDR 62-684, Oct. 1962, 75 p., incl. illus., tables, 11 refs., AD 290 620.

STUDY OF OPTICAL FIBER TECHNIQUES FOR DATA PROCESSING
C. J. Koester, American Optical Co., Southbridge, Mass., Final rept., RADC TDR 62-478, Aug. 1962, 41 p., AD 299 007.

PULSED LIGHT INVESTIGATION
W. J. Nolan, Jr., Motorola, Inc., Riverside, Calif. Final engineering rept. on Based-Sensing Techniques and Development, ASD TDR 62-546, June 1962, 81 p., incl. illus., tables, AD 284 419.

. . . The possibility of decreasing the size and increasing the brightness of spark discharges by immersing the electrodes in oil was investigated over the range of 0.05 to 20 joules stored energy and 1 to 10-kv initial voltage. . . . At 10 kv, a discharge of 10 joules showed higher brightness in oil than in air (but not higher than an air discharge at 5 kv) and considerably decreased electrode wear. . .

INFRARED FIBER OPTICS
D. A. Pontarelli, et al., Armour Research Foundation, Chicago, Ill., Quarterly progress rept. 7, Rept. ARF 1139-19, 27 Dec. 1960, 6 p., AD 250 458.

STUDY OF FACSIMILE SCANNING AND RECORDING TECHNIQUES EMPLOYING FIBER OPTICS
D. A. Pontarelli, IIT Research Inst., Chicago, Ill. Quarterly rept. no. 4, 15 Sept.-15 Dec. 1962, Rept. no. ARF A1203 13, 4 p., AD 410 289.

FIBER OPTICS IN AEROSPACE VEHICLE HAZARD DETECTION
A. C. Traub, Fenwal, Inc., Ashland, Mass., Final rept. 8 March 1961-30 June 1962, ASD TDR 62 731, Dec. 1962, 212 p., AD 403 387.

Light-transmitting glass fiber bundles in various configurations have been subjected to extensive optical, mechanical and thermal testing. . .

CONSTRUCTION OF CAPACITOR-TYPE LIGHT SOURCES
H. Wierzba, Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 1 Feb. 1962, 18 p., Trans. no. FTD-TT-61-24 of Przeglad Elektrotechniczny 36, issue no. 9: p. 355/359, AD 271 849.

. . . Two types of sources are discussed: the first one—built on glass plates in which the electroluminophore is placed in organic resin; the second one—on metal plates wherein the electroluminophore is placed in inorganic enamel. The characteristics and components of the materials used in construction of the capacitor-type light sources are noted.

EXPERIMENTAL CATHODE RAY TUBES WITH FIBER OPTIC INSERTS IN FACE-PLATE
Rauland Corp., Chicago, Ill., Final Engineering Rept. 1962, 13 p., AD 400 246.

See also AD 283 420.

AIRBORNE FLASHING LIGHT BEACON
Land-Air, Inc., Holloman, N. Mex., April 1962, 14 p., 2 refs., N63-15959.

BLACK KNIGHT ELECTRONIC FLASH INSTALLATION FOR OPTICAL TRACKING
R. L. Aspden, Electronic Engng., vol. 36, Feb. 1964, p. 88/91, A64-14147.

Description of a flash-tube system designed to meet the requirements for a tracking light system, to be mounted on a Black Knight rocket. . . .

WEAK NON LINEAR OPTICAL INTERACTIONS
N. Braslau, et al., International Business Machines Corp., Yorktown Heights, N. Y., March 18, 1963, 26 p., 5 refs., N63-23173.

. . . Harmonic generation and mixing of optical signals have been demonstrated in suitable crystals where a high intensity optical maser beam has induced a nonlinear polarization in the crystal. . .

OPTICAL SYSTEMS USING FIBER OPTICS
D. F. Capellaro, Optics Technology, Inc., Belmont, Calif., In AGARD, Paris Light and Heat Sensing 1963, p. 311/324, N64-15473.

. . . Through a new technique, it has also become possible to view and to image opaque objects through fibers alone. . . demonstrate the practical application of fiber optics.

RESEARCH AND INVESTIGATION IN THE FIELD OF FIBER OPTICS
H. B. Cole, et al., American Optical Co., Southbridge, Mass., ASD TDR63 375, July 1963, 150 p., AD 416 587.

. . . Efforts to develop designs and fabrication techniques for making large (3 to 5 in. diameter) vacuum-tight fused fiber optic plates consisting of 5 to 10 micron diameter fiber elements and having high numerical aperture, resolutions, and optical quality, high signal transmission efficiency and low stray-light characteristics are reported in detail. These plates are intended for use in image intensifier tube . . .

A NONFRAMING, FIBER OPTICS MOTION-PICTURE CAMERA
J. J. Forkner, et al., Photographic Science and Engineering, vol. 8, Jan.-Feb. 1964, p. 7/12, 11 refs., A64-14930.

Description of a fiber optics motion-picture camera which circumvents the problems of synchronization and special scan rates associated with the use of motion pictures as inputs to television systems. . . .

CLASSICAL THEORY OF THE DIRAC ELECTRON
Z. Grossman, et al., Society of Automotive Engineers, Automotive Engineering Congress, Detroit, Mich., Jan. 13/17, 1964, Paper 816B, 6 p., A64-12073.

Review of the experimental procedure used in generating very high intensity pulsed laser beams. This is followed by a discussion of the experiments to date using these high intensity beams to observe electrical breakdown at optical frequencies and nonlinear optical effects. Possible applications are also discussed briefly.

FIBER OPTICS TRACK/SCAN SYSTEM
K. W. Harper, General Electric Co., Ithaca, N. Y., Advanced Electronics Center, April 1963, 7 p., N63-19667.

VARIATION OF ARC RESISTANCE AND ARC POWER WITH CURRENT IN PULSED XENON OPTICAL PUMP LAMPS (Correspondence)
H. G. Heard, Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1234/1235.

THIN FILM TUNNELUMINESCENCE (Correspondence)
R. M. Hill, vol. 51, no. 11, Nov. 1963, p. 1664.

Tunneluminescence, the emission of light from a phosphor film deposited on the surface of a thin film metal-oxide sandwich, has been observed in two similar structures. . . .

NONLINEAR OPTICAL PHENOMENA IN SCATTERING MEDIA (Translation)
A. P. Ivanov, Optics and Spectrosc., vol. 14, Feb. 1963, p. 142/147, 13 refs., A63-20192.

Theoretical study of the phenomena of opacity decrease, luminescence, amplification, and self-excitation as functions of the optical characteristics of light-scattering substances. The intensity of generation in the presence of inhomogeneities in the system is calculated within the framework of geometrical optics. . . .

NONLINEAR EFFECTS CONVERT LASER BEAM, AMPLIFY LIGHT
W. Kornberg, Electronics, vol. 36, May 3, 1963, p. 30/32, A63-17865.

. . . By proper selection of nonlinear optical materials, as calcite crystals, laser frequencies can be added or subtracted to obtain results anywhere in the visible spectrum. It is also suggested that parametric amplification is possible, by allowing, for example, laser light to pass through liquid nitrogen. . . .

PROPOSAL FOR BEATING TWO OPTICAL MASERS
G. D. Mahan, et al., J. Appl. Phys., vol. 34, May 1963, p. 1531/1534, 12 refs., A64-10663.

Proposition of an experimental arrangement with which two optical masers may be made to beat to produce a far-infrared source. The beating process occurs in a semiconductor which lacks inversion symmetry, allowing the third-order process. By selecting a semiconductor with an appropriate energy gap, the energy denominators in the matrix element may be made small, enhancing the infrared intensity. . . .

NONLINEAR OPTICAL PROPERTIES OF SOLIDS: ENERGY CONSIDERATION. APPENDIX - TIME-REVERSAL TRANSFORMATION
P. S. Pershan, Phys. Rev., 2nd Series, vol. 130, May 1, 1963, p. 919/929, 26 refs., A63-17806.

Demonstration of the interaction between macroscopic, nondissipative media, and time-varying electromagnetic fields that can be described by a time-averaged potential function. . . .

STUDY OF FACSIMILE SCANNING AND RECORDING TECHNIQUES EMPLOYING FIBER OPTICS
D. A. Pontarelli, IIT Research Inst., Chicago, Ill. Quarterly prog. rept. no. 8, 15 Oct. 1963-15 Jan. 1964, Rept. no. IITRI A1203 25, 15 Jan. 1964, AD 434 444.

See also AD 434 382, AD 426 818.

FIBER OPTICS-PRINCIPLES, PROPERTIES AND DESIGN CONSIDERATIONS
W. P. Siegmund, American Optical Co., Southbridge, Mass, In AGARD, Paris, Light and Heat Sensing, 1963, p. 265/296, refs., N64-15471.

A FIBER OPTIC SENSING DEVICE
Radio Corp., of America, Camden, N. J., Griffiss AFB, N. Y., Inform. Process. Lab., RADC TDR-63-438, Oct. 1963, 59 p., refs., AD 424 987, N64-12210.

. . . describes a fiber optic device which has optical inputs and analog current outputs. Fiber optics were used in order to preserve the analog nature of the input patterns. The device as built will be used as an optical input device for the analog learning machine under construction at Rome Air Development Center.

FIBER OPTICS AND ITS USE IN ELECTRO-OPTICAL DEVICES
L. J. Krolak, Radio Corp. of America, Camden, N. J. Defense Electronic Products, In AGARD, Paris, Light and Heat Sensing, 1963, p. 297/310, N64-15472.

STUDY OF FACSIMILE SCANNING AND RECORDING TECHNIQUES EMPLOYING FIBER OPTICS
IIT Research Inst., Chicago, Ill. Quarterly rept. no. 2, Rept. no. A1203 7, 4 Nov. 1963, 9 p., AD 423 755.

. . . utilization of dielectric fibers in a facsimile scanner and recorder. An elemental scanner was constructed to study scanning parameters and resolution of fiber optics illuminating and scanning systems. For the purpose, an automatic microdensitometer, . . . was modified. . . A study of strength coefficients of coated fibers was initiated. . . .

Related Publications:

WAVE PROPAGATION IN NONLINEAR ELECTROMAGNETIC MEDIA
N. Bloembergen, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 124/131.

. . . tutorial review . . .

Section 3B.33

3B.330: Optical Components

Included: Optical arrays; Optoelectronic logic; Optical resonators; Optical lattice filters; Optoelectronic functional electronic blocks; Photon coupled circuits; Optical scanning devices; Solid-state opto-electronics.

Not Included: Optical devices in data processing systems (3A); Microelectronics.

Cross References: Lasers (Sect. 3B.24).

Principal Publications:

OPTICAL INFORMATION HANDLING WITH THIN MAGNETIC FILMS
L. Kleinrock, Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 789/797.

. . . considers an optical method for extracting stored information from thin magnetic films based on the Kerr magneto-optic effect. . . .

FILTERING OPERATIONS USING COHERENT OPTICS
L. J. Cutrona, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 262/275.

Coherent optical systems have the inherent property that a Fourier transform relation exists between the light amplitude distributions at the front and back focal planes of a lens used in such a system.

SOLID-STATE OPTOELECTRONICS
E. E. Loebner, RCA Rev., vol. 20, no. 4, Dec. 1959, p. 715/743.

A discussion of the harnessing of photoelectric and luminescent phenomena is preceded by a brief classification and explanation. This is followed by a description of optoelectronic modulators and amplifiers. . .

OPTICAL DATA PROCESSING AND FILTERING SYSTEMS
L. J. Cutrona, et al., IRE Trans. Inform. Th., vol. IT-6, no. 3, June 1960, p. 386/400.

THE RAYSISTOR, AN ELECTRICAL TRANSFORMER USING OPTICAL COUPLING
J. C. Davis, Jr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 212/213.

This device could be called an amplifier, but its output is not necessarily a sole function of input. It could be called a modulator, or a relay, as it can be used to control a signal or carrier with a control current. . . . Basically, what is wanted is a relay capable of very high speeds and using low power. . . . The Raysistor consists of a fast, high-intensity light driving a sensitive, fast, photo-resistive cell. . . .

THE DESIGN OF OPTICAL DIGITAL INSTRUMENTS
I. R. Young, Electronic Engng., vol. 32, no. 388, June 1960, p. 359/365.

COHERENT OPTICAL SURVEILLANCE DEVICES
R. E. Bradbury, Electro-Optical Systems, Inc., Pasadena, Calif., EOS rept. no. 2230-Q-1, RADC TDR 62-292, 1 June 1962, 25 p., incl. illus., tables, AD 283 052.

. . . development of coherent optical components operative over the spectral range from 0.5 to 0.8 microns. . . . designs finalized for a gas cell variable phase shifter to provide 180 degrees phase shift of light at 7000 angstroms with a sensitivity of better than 1 degree. A study of the relative merits of double beam and multiple beam methods of calibrating the phase shifter using incoherent light was made. . . . (See also AD 287 211.)

INVESTIGATIONS ON A BEAM WAVEGUIDE FOR OPTICAL FREQUENCIES
G. Goubau, et al., Army Research Office, Office of the Chief, Research and Development, Wash., D.C., 1962, 11 p., incl. illus., 5 refs., AD 286 641.

. . . The beam waveguide is a transmission device for the millimeter and submillimeter frequency range. It utilizes reiterative wavebeams which are guided by resetting the cross-section phase distribution of the beam at periodic intervals. . . . beam waveguide of 970m length was constructed for the optical frequency range. The phase transformation is performed at intervals of 97m by plane-convex glass lenses of 2cm diameter and a focal length of 48.5m. . . .

OPTICAL SCANNING USING ELECTRICALLY-MODULATED MEMBRANE MIRRORS
Semiannual technical rept. no. 1, Oct. 1961-Jan. 1962. Jan. 1962, 114 p., incl. illus., tables, AD 277 164.

OPTICAL SCANNING USING ELECTRICALLY MODULATED MEMBRANE MIRRORS
E. J. Astwood, et al., Irco Corp., New York Semi-annual technical rept. no. 3, Jan.-July 1963, suppl. to final rept. July 1963, 25 p., AD 415 943.

OPTOELECTRONIC FUNCTIONAL ELECTRONIC BLOCKS
J. R. Biard, Texas Instruments, Inc., Dallas. Interim engineering rept. no. 2, 1 Nov. 1963-31 Jan. 1964, Rept. no. 04 64 20, 27 March 1964, 61 p., AD 434 170.

. . . an effort to extend the applicability of integrated circuits. The combination of the isolation feature of optical coupling with existing silicon integrated circuit technology has suggested a new series of Optoelectronic Functional Electronic Blocks. . . design and fabrication of an Optoelectronic Pulse Amplifier and an Optoelectronic DC amplifier. . . .

CONSIDERATIONS IN OPTOELECTRONIC LOGIC AND MEMORY ARRAYS
T. E. Bray, General Electric Co., Electronics Lab., Syracuse, N. Y., Jan. 1963, 34 p., 23 refs; Presented at the 1962 Symp. on Opt. Process. of Inform., Wash. D. C., N63-18905.

LENS DESIGNING WITH THE 1962 LASL CODE FOR THE IBM 7090
B. Brixner, Los Alamos Scientific Lab., N. Mex., LA-2877, 5 June 1963, 46 p., 8 refs., N63-17947.

ANALYSIS OF GENERALIZED OPTICAL ARRAYS
E. B. Champagne, Air Force Avionics Lab., Aeronautical Systems Div., Wright-Patterson AFB, Ohio., Dec. 1963, 30 p., AD 431 567.

The extension of present microwave array theory to arrays of optical sources is studied. . . .

AN ANALYSIS OF MULTIREFLECTOR OPTICAL RESONATORS
P. O. Clark, Quantum Electronics Lab., Calif. Inst. of Tech., Pasadena, 27 Feb. 1964, 91 p., AD 437 795.

MULTI REFLECTOR OPTICAL RESONATORS (Correspondence)
P. O. Clark, Proc. IEEE, vol. 51, no. 6, June 1963, p. 949/950.

MULTI REFLECTOR OPTICAL RESONATORS
P. O. Clark, Quantum Electronics Lab., Calif. Inst. of Tech., Pasadena, AFCRL 63 115, 10 April 1963, 6 p., AD 406 323, N63-16686.

. . . describes an analysis based on geometrical optics which determines the conditions for stable operation of devices employing lasers. . .

OPTICAL LATTICE FILTERS FROM THE WAVE FIELD OF LASER RADIATION (Correspondence)
R. Gerharz, Proc. IEEE, vol. 51, no. 5, May 1963, p. 862/863.

A little-explored field of application for quantum electronic light sources is the creation of multipass-band optical filters. . . .

AN OPTICAL ABSORPTION FILTER UTILIZING KERR EFFECT DISPERSION (Correspondence)
M. P. Grant, et al., Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1364/1365.

. . . At present these shutters are commonly used to control pulses from lasers. . . This absorption filter may be used to suppress one wavelength so as to detect a weak line in the presence of a strong one, as in searching for optical harmonics, or as an optical absorption wavemeter. . . .

STUDIES, RESEARCH AND INVESTIGATIONS OF THE OPTICAL PROPERTIES OF THIN FILMS OF METALS SEMI CONDUCTORS AND DIELECTRICS
L. N. Hadley, Colorado State U., Fort Collins, Semi annual rept. no. 7, 16 Aug. 1962-15 Feb. 1963, AD 409 956.

DESIGN AND FABRICATION OF OPTICAL FILTERS FOR LASER FREQUENCY
S. J. Holmes, et al., Spectrolab, Inc., North Hollywood, Calif. Quarterly progress rept. no. 1, 11 Feb.-9 May 1963. 24 May 1963, 21 p., AD 412 546.

. . . fabricating very narrow band interference filters. . . causes and effects of film inhomogenities. . . . Uniform films over a relatively large area have been obtained for constant pressure at 5 x 1/100, 000 mm Hg. However, it is felt that even better uniformity could be obtained at pressures below 1 x 1/100, 000 mm Hg. . . . See also AD 419 554, AD 427 005.

OPTICAL WAVEGUIDE OF MACROSCOPIC DIMENSIONS IN SINGLE-MODE OPERATION (Correspondence)
R. A. Kaplan, Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1144/1145.

FABRICATING LARGE ADVANCED OPTICAL SYSTEMS
S. R. Sixbey, Space Dimensions, vol. 1, Feb. 1964, p. 11/14, A64-15487.

Consideration of material and design problems in the construction of large high-performance optical instruments which can be located either in aircraft, in satellites, or on the ground. . . .

PHOTON COUPLED CIRCUITS
I. Wunderman, HF Associates, Palo Alto, Calif., Jan. 1964, 81 p., AD 433 730.

When appropriately-fabricated gallium arsenide diodes are biased in the forward direction, they emit a narrow band of radiation in the near infrared. This mechanism, termed injection luminesence, has achieved a state of technological perfection which permits exploitation as an active electronic device. This report describes the capabilities of circuits which can be made by mating these emitting sources to suitable photodetectors, forming photon-coupled pairs. The unique properties of such configurations are isolation of input and output circuits, and unilateral signal transfer. . . .

OPTICAL TECHNIQUES FOR TARGET ENHANCEMENT AND BACKGROUND REJECTION
Te Co., Santa Barbara, Calif., Final technical rept., Rept. no. 2001, June 1963, 56 p., AD 415 478.

. . . having the function of selecting or enhancing certain systematic targets and rejecting other systematic backgrounds by virtue of geometry, color, motion and possibly polarization. . . .
(See also AD 408 268.)

Related Publications:

AN ELECTRO-OPTICAL SHIFT REGISTER
T. E. Bray, IRE Trans. Electronic Comp., vol. EC-8, no. 2, June 1959, p. 113/117.

OPTICAL ANALOG COMPUTERS
B. J. Howell, J. Opt. Soc. Amer., vol. 49, Oct. 1959, p. 1012/1021.

THE HIGH GAIN LASER AS A WAVELENGTH STANDARD
L. F. Mollenauer, et al., Microwave Lab., Stanford U., Calif., Rept. no. 1139, 1963, 16 p., AD 433 118.

. . . intended as a convenient secondary frequency standard for spectroscopic work. . . a device, using a clad ruby rod immersed in liquid nitrogen, and without adjustments, has generated a single line whose stability and width are better than two parts in 0.0000001.

Section 3B.34
Lasers

3B.340: General References on Lasers

Included: Bibliographies; Introductions; Surveys; Progress reviews.

Not Included: Laser materials.

Cross References: Application of lasers (3B.380); Laser communications systems (Div. 3B.4).

Principal Publications:

THE OPTICAL MASER
C. G. B. Garrett, Electrical Engineering, vol. 80, no. 4, April 1961, p. 248/251.

. . . review of laser operation . . .

LASERS: DEVICES AND SYSTEMS - PART I
S. Vogel, et al., Electronics, vol. 34, no. 43, Oct. 1961, p. 39/47.

. . . introduction to Lasers . . . survey. Much bibliographical data . . .

PROGRESS OF LASER TECHNIQUE (In German)
H. Awender, Radio Mentor, vol. 28, no. 12, Dec. 1962, p. 1016/1020.

A review of progress . . . since Sept. 1961 . . .

PROGRESS IN OPTICAL MASERS
R. J. Collins, Institute for Defense Analyses, Washington, D. C., Dec. 1962, 23 p., AD 429 057.

A brief review of the background and state of the art of optical masers is presented.

OPTICAL MASER PROGRAM AT AMERICAN OPTICAL COMPANY
E. Dixon, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 364/368.

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G. Gould, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 190/193.

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O. S. Heavens, Appl. Optics, Suppl. 1, 1962, p. 1/23, 92 refs.

Concepts basic to the understanding of optical masers are discussed, and a review of progress made. . . . applications in the areas of fundamental experiments, communications, instrumentation and surgery discussed.

LASERS: GENERATION OF LIGHT BY STIMULATED EMISSIONS
B. A. Lengyel, New York 1, John Wiley and Sons, Inc., 1962, 106 p.

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T. H. Maiman, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 188/189.

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B. M. Oliver, Proc. IRE, vol. 50, Feb. 1962, p. 135/141.

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M. Pauthier, Elect. Commun., vol. 37, no. 4, 1962, p. 377/386.

LASERS
I. G. Ross, Proc. Instn. Radio Engrs. Australia, vol. 23, no. 3, March 1962, p. 171/177.

. . . a general review. Their construction and mode of operation are outlined, with special emphasis on the process of stimulated emission and on the inversion of thermal populations. . . . The comparison with conventional sources of visible radiation, all of which are incoherent, is especially stressed. . . .

OPTICAL MASERS
J. H. Sanders, J. Brit. Instn. Radio Engrs., vol. 24, no. 5, Nov. 1962, p. 365/372.

. . . review of the present situation . . . Various types of optical maser which have been successfully operated are described. . . . The unique features of high spectral purity and narrow beamwidth are pointed out, and some present and future applications are discussed. . . .

SPACE COMMUNICATIONS BY THE USE OF LASERS: AN ENUMERATIVE BIBLIOGRAPHY
P. L. Simmons, IRE Trans. Commun. Sys., vol. CS-10, Dec. 1962, p. 449/456, 379 refs.

Bibliography on lasers, surveying the research and development which has been accomplished in their short history. Included are English, French, and Soviet articles published up to early 1962. A brief introduction to lasers is given.

LASERS FOR AEROSPACE WEAPONRY
J. Sirons, Navigation and Guidance Lab., Aeronautical Systems Div., Wright-Patterson Air Force Base, Ohio, Summary rept. on Weaponization of Submillimeter Electromagnetic Technique, ASD TDR 62-440, May 1962, 42 p., incl. illus., AD 278 521.

A summary of the state-of-the-art in Laser research . . . present ruby laser . . . Research to improve existing lasers is described, including new crystal materials, new sources of optical energy, and new Lasering techniques. A program is outlined to direct future Laser research and apply the developments effectively.

LASERS: A BIBLIOGRAPHY COVERING THE PERIOD DECEMBER 1958-MAY 1962
K. J. Spencer, Gt. Brit. Ministry of Aviation, Technical Information and Library Services, Nottingham, Its Bibliographical Series No. 4, May 1962, 41 p., 409 refs., N63-16379.

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H. Statz, Semiconductor Prod., vol. 5, no. 8, Aug. 1962, p. 17/24.

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W. H. Wells, JPL Space Progr. Summ., vol. 4, no. 37-16, June/July 1962, p. 62/68.

. . . problem of measuring the power output from a laser.

ELECTRONICS PROGRAM. QUANTUM ELECTRONICS
Aerospace Corp., El Segundo, Calif., Semiannual tech. rept., 1 July-31 Dec. 1961, Rept. no. TDR-930 2250-20 TR-1, 28 Feb. 1962, 29 p., refs, AD 274 705.

A laser employing an rf-excited gas discharge in a mixture of helium and neon is being studied analytically and experimentally. . . . The study of the interaction of intense coherent optical beams with materials has started. Preliminary experimental work with low-power and medium-power lasers is described. . . .

STRUCTURE OF SOVIET MASER AND LASER RESEARCH
Aerospace Information Div., Washington, D. C., AID rept. no. 62-84, 17 Aug. 1962, 29 p., incl. illus., 153 refs., AD 284 025.

. . . key avenues of research and the functional distribution of the leading Soviet scientific personnel engaged in maser development. . . . correlative analysis was applied to significant research reports, reviews of scientific development, tutorial papers, and popular articles published in the USSR in the field of maser research since its inception around 1954, to the present. The four main areas of Soviet maser research which are presented graphically are: (1) semiconductors (infrared and optical ranges); (2) paramagnetics (all ranges); (3) gas media (infrared and optical ranges); and (4) molecular beams (microwave range).

OPTICAL MASER RESEARCH
Bell Telephone Labs, Inc., Murray Hill, N. J., Final rept. 15 July 1961-14 July 1962, 15 Sept. 1962, 53 p., AD 299 354.

LASERS. A BIBLIOGRAPHY
North American Aviation, Inc., Downey, Calif., Rept. no. SID 62 267, 20 Feb. 1962, 44 p., AD 421 577.

The open and documentation literature of lasers from its inception through January 1962 is presented.

BIBLIOGRAPHY OF THE OPEN LITERATURE ON LASERS. II
E. V. Ashburn, et al., J. Opt. Soc. Amer., vol. 54, Jan. 1964, p. 135/142, A64-13040.

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MASERS AND LASERS (SUPPLEMENT). A DDC REPORT BIBLIOGRAPHY
M. F. Aukland (comp.), Defense Documentation Center, Alexandria, Va., Bibliography for Feb. 1962-March 1964, March 1964, 1v., AD 431 800.

. . . updating of . . . AD 271 100 . . . The supplement has developed different subject breakdowns than that of the first edition. . . .

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J. E. Bradley, Ohio State U., Research Foundation, Columbus Antenna Lab., Rept. 1093-17, 1 May 1963, 298 p., refs., N64-11733.

. . . dealing with the nature of crystals and glasses, and to a lesser extent with some of the possible laser ions . . .

LASERS AND THEIR APPLICATIONS
D. A. Buddenhagen, Society of Automotive Engineers, Automotive Engineering Congress, Detroit, Mich., Jan. 13-17, 1964, Paper 819A, 13 p., 18 refs., A64-15548.

. . . several applications for lasers which are most promising . . . The properties of lasers are presented, and over 50 active laser materials are tabulated. Applications in many fields, such as micromachining, microwelding, photography, communications, optical ranging, meteorology, chemistry, biological sciences, and others, are discussed.

LASERS AND THEIR EFFECTS
J. H. Burkhalter, Martin-Marietta Corp., Orlando, Fla., Annual progress rept., 1 July 1963-1 March 1964, Rept. no. OR 3885, 1 April 1964, 54 p., AD 433 218.

The biological effects of lasers and laser radiation are described. . . .

COHERENT LIGHT TRANSMITTER TECHNIQUES
D. M. J. Compton, General Atomic Div., General Dynamics Corp., San Diego, Calif., Semiannual rept., 5 Aug. 1963-5 Feb. 1964, Rept. no. GACD5078, 9 March 1964, 89 p., AD 435 143.

THIRD INTERNATIONAL SYMPOSIUM ON QUANTUM ELECTRONICS
J. deLaunay, Office of Naval Research, London, Tech. rept. no. ONRL-C-2-63, 28 March 1963, 7 p., AD 401 426.

Contents: The laser as a means of testing the theory of relativity . . . Fiber lasers . . . Phonon lasers . . .

PROCEEDINGS OF THE SYMPOSIUM ON OPTICAL MASERS, NEW YORK, N. Y. APRIL 16, 17, 18, 19, 1963
J. Fox (editor), Microwave Research Inst., Polytechnic Inst. of Brooklyn, N. Y., 1963, 652 p., AD 431 690.

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J. E. Geusic, et al., Bell Telephone Labs., Inc., Murray Hill, N. J., Quarterly rept. no. 1, 15 July-14 Nov. 1963, 14 Nov. 1963, 39 p., AD 433 775.

. . . first successful demonstration of pulsed and CW optical maser oscillations in Nd; YAG. . . . crystal field calculations for some of the states of trivalent rare-earth ions in YAG. . . .

LASER MATERIALS AND DEVICES - A RESEARCH REPORT
R. D. Haun, Electro-Technology, vol. 72, Sept. 1963, p. 63/71, 16 refs., A63-22696.

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R. Kaplan, Technical Research Group, Syosset, N. Y., Quarterly technical summary rept. no. 7, 1 Dec. 1963 - 29 Feb. 1964, Rept. no. 134QTR7, 29 Feb. 1964, 1v., AD 437 576.

SOVIET LASER RESEARCH (Correspondence)
S. Kassel, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 216/218.

MICROWAVE AND OPTICAL MASERS FOR MM WAVES
Z. J. Kiss, David Sarnoff Research Center, Princeton, N. J., Quarterly rept. no. 1, 1 Nov. 1962-31 Jan. 1963, 31 Jan. 1963, 14 p., AD 407 549.

LASERS - GENERATION OF LIGHT BY STIMULATED EMISSION
B. A. Lengyel, New York, John Wiley and Sons, Inc., 1963, 125 p.

Review of the laser state-of-the-art and its present level of achievement. . . . emphasizes principle rather than engineering design . . .

LASERS
H. R. Lewis, et al., Radio Corp., of America, Camden, N. J., Defense Electronic Products, 1963, 31 p., refs., N64-12559.

LASER TECHNOLOGY: AN ANNOTATED BIBLIOGRAPHY
H. B. McCormick (comp.), Lockheed Aircraft Corp., Sunnyvale, Calif., Rept. no. 5 73 63 6; SB 63, AD 431 290, N64-15978.

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A. L. Mikaelian, et al., Radio Engng. Electronic Phys., vol. 8, May 1963, p. 757/778, 77 refs., A64-15765.

Review of the present state of research activities in the field of lasers . . .

MASERS AND LASERS: A BIBLIOGRAPHY. 1962 SUPPLEMENT
J. F. Price, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Research Bibliography 45, Rept. 9990-6369-KU2000, Suppl. to N62-16763, March 1963, 182 p., 1134 refs., N63-22774, AD 299 050.

RESEARCH ON PROPERTIES OF LASER DEVICES
S. Rothberg (editor), Technical Research Group, Inc., Melville, N.Y., Fifth Quarterly Technical Summary Report, June 1963-Aug. 1963, 1963, 134 p., refs., N63-23556.

. . . limitations on power and efficiency of gas lasers . . . literature search for transition metal molecules suitable for high-power gas lasers . . . Various crystalline and non-crystalline media containing rare-earth elements have been prepared . . .

RESEARCH ON PROPERTIES OF LASER DEVICES
S. Rothberg, et al., Technical Research Group, Syosset, N.Y., Quarterly technical summary rept. no. 6, Rept. no. TRG134QTR6, 1 Sept. 1963-30 Nov. 1963, AD 427 259.

. . . The effect of the index of refraction of the laser material on the required brightness of the pumping lamp was determined . . . A study of excitation and recombination processes was performed . . . for the tellurium collision laser . . . An improved apparatus for the photodissociation laser was assembled . . .

LASERS AND COHERENT LIGHT
A. L. Schawlow, Physics Today, vol. 17, Jan. 1964, p. 28/33, 7 refs., A64-15503.

General description of lasers and their capabilities. . . .

ADVANCES IN OPTICAL MASERS
A. L. Schawlow, Scientific American, vol. 209, July 1963, p. 34/45, A63-20307.

OPTICAL AND INFRA-RED MASERS
A. L. Schawlow, Contemporary Phys., vol. 5, Dec. 1963, p. 81/102, 69 refs., A64-15500.

Discussion of masers (lasers) which operate at infrared, visible, or shorter wavelengths . . . laser materials, methods of excitation, gas-discharge-optical masers, semiconductor masers, giant-pulse lasers, and extremely monochromatic optical masers . . . Possibly the most important scientific results obtained so far have been in opening the field of nonlinear optics.

OPTICAL AND INFRARED MASERS
J. Siddoway, et al., JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 137/148.

It appears feasible to build a maser as a source of coherent radiation in the far infrared. The means of excitation is analogous to a heat engine.

OPTICAL MASERS
J. R. Singer, IN: Cryogenic Technology, Edited by Robert W. Vance, New York, John Wiley and Sons, Inc., 1963, p. 311/331, 114 refs., A63-22997.

Discussion of the optical or electronic excitation of gases and solids, and of the consequent coherent emission in the submillimeter, IR, or optical frequencies. . . .

LASERS—A BASIC DISCUSSION OF TYPES, PROPERTIES, AND PRINCIPLES
C. M. Stickley, Air Force Cambridge Research Labs., Bedford, Mass., Rept. no. AFCRL-63-1, Jan. 1963, 23 p., 6 refs., AD 401 888.

. . . includes a quantitative discussion of the major properties and the different types of lasers, as well as the basic laser mechanism-stimulated emission. . . . applications . . .

MASERS AND LASERS
G. Troup, New York, John Wiley and Sons, Inc., London, Methuen and Co., Ltd., 1963, 192 p., 118 refs., A64-17349.

. . . comprises a survey of the state of the maser and laser art . . . It is directed to advanced students and workers in the field. . . . Supplementary material includes a bibliography of seventeen works, and an index.

ADVANCES IN LASERS
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A. Yariv, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 4.

. . . a review of the field of optical masers . . . summarizing both theory and practice . . . The sections on optical resonators and communications which conclude the paper have been slightly emphasized since, perhaps to a larger extent than the other topics covered in this paper, they coincide with traditional areas of interest of microwave and communications engineers.

A DIRECTORY OF LASER ORGANIZATIONS
Semiconductor Products, vol. 6, Aug. 1963, p. 48/50, 56/62, A63-21057.

Listing of approximately 150 organizations active in the laser field. . . . (1) laser suppliers . . . (2) laser materials suppliers . . . (3) laser accessory equipment suppliers . . . (4) laser research and development groups. . . .

CONFERENCE ON OPTICAL MASERS, LONDON, SEPTEMBER 1962
J. Sci. Instrum., vol. 40, no. 3, Feb. 1963, p. 89/90.

. . . a total of 11 papers . . . experimental and theoretical studies of the properties of optical masers . . . some new thoughts on population inversion.

LASER DEVICES EXPLORATORY INVESTIGATION
Hughes Research Labs., Malibu, Calif., Interim scientific rept. no. 3, 1 Nov. 1963-31 Jan. 1964, 31 Jan. 1964, 82 p., AD 429 856.

Related Publications:

STUDY ON OPTICAL COMMUNICATIONS FROM DEEP SPACE
K. L. Brinkman, Hughes Aircraft Co., Culver City, Calif., Interim Progress Report, 7 Jan.-1 Feb. 1963, 1963, 50 p., refs., N64-16711.

A preliminary survey of operating lasers and their characteristics is presented. Particular emphasis is placed upon CW operating lasers (solid state and gas), the properties of the gallium arsenide lasers, and solar pumped lasers . . . their use as optical communications systems components . . . Bibliographies on the following subjects are presented: laser materials and devices; modes and optical properties of laser emission; modulation, mixing, detection, etc.; and theory, pumping and miscellaneous considerations.

LASERS FOR COMMUNICATIONS AND OPTICAL RANGING
G. F. Smith, Hughes Research Labs., Malibu, Calif., In AGARD, Paris Light and Heat Sensing, 1963, p. 221/234, refs., N64-15469.

. . . In a one-way communications link with constant-aperture diffraction-limited antennas, the fraction of transmitted power that is received is proportional to the square of the frequency. Signal fluctuation noise, however, increases linearly with frequency. At optical frequencies, aiming problems are likely to limit the useful degree of beam collimation; thus, on the basis of bandwidth per transmitted watt, a laser space-communications link will be competitive with, but drastically superior to, a futuristic microwave space link. The high-power pulse performance of ruby lasers is promising for optical ranging . . .

3B.341: Theory of Laser Operation

Included: Laser modes of operation; Optical giant pulses; Mode splitting; Q-spoiling effects; Pulsed transmission modes in lasers; Theory of laser regenerative switching.

Not Included: Fundamentals of laser materials.

Cross References: Measurements of laser characteristics (3B.349).

Principal Publications:

RESONANT MODES IN AN OPTICAL MASER (Correspondence)
A. G. Fox, et al., Proc. IRE, vol. 48, Nov. 1960, p. 1904/1905.

RESONANT MODES IN A MASER INTERFEROMETER
A. G. Fox, et al., Bell Syst. Tech. J., vol. 40, no. 2, March 1961, p. 453/488.

. . . to study diffraction of electromagnetic waves in Fabry-Perot interferometers when they are used as resonators in optical masers.

A GENERAL ANALYSIS OF OPTICAL, INFRARED, AND MICROWAVE MASER OSCILLATOR EMISSION
J. R. Singer, et al., Electronics Research Lab., U. of Calif., Berkeley, 21 March 1961, 8 p., AD 256 632.

The equations are generalized governing coherent emission from quantum mechanical amplifiers (microwave, infrared, and optical masers) using either electric or magnetic dipole transitions.

REPETITIVE HAIR-TRIGGER MODE OF OPTICAL MASER OPERATION (Correspondence)
M. L. Stitch, et al., Proc. IRE, vol. 49, Oct. 1961, p. 1571/1572.

MODE SUPPRESSION AND SINGLE FREQUENCY OPERATION IN GASEOUS OPTICAL MASERS (Correspondence)
H. Kogelnik, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2365/2366.

. . . observed the suppression of unwanted longitudinal modes in an inherently multimode He-Ne maser oscillator. . . .

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M. D. Rubin, Proc. IRE, vol. 50, no. 4, April 1962, p. 471/472.

OPERATION OF A FOUR-LEVEL OPTICAL QUANTUM GENERATOR (Translation)
I. A. Anan'ev, et al., Soviet Physics—JETP., vol. 17, Dec. 1963, p. 1268/1270, A64-13287.

. . . based on the steady-state theory of four-level laser. An equation is developed which shows that the optimum value for transmission depends on the loss in the crystal and on the pump power . . . The experiments were carried out on cylindrically-shaped crystals whose end surfaces were covered with a dielectric reflecting layer. . . . the elementary theory of steady-state generation . . . satisfactorily describes the principal features of a four-level laser.

SVOISTVA GHETYREKHUROVNEVOGO OPTICHESKOGO KVANTOVOGO GENERATORA (Properties of a Four-Level Optical Quantum Generator) (In Russian)
I. A. Anan'ev, et al., Akademiia Nauk SSSR, Doklady, vol. 150, May 21, 1963, p. 507/510, A63-21895.

VARIATION OF REFRACTIVE INDEX DURING LASER OPERATION
J. R. Izatt, et al., New Mexico State U. of Agriculture, Engineering and Science, University Park, Semi-annual technical rept. no. 1, Jan. 1964, 22 p., AD 427 725.

The refractive index of a laser in the region of anomalous dispersion surrounding the active laser frequency should vary as the relative population of states changes . . . can be studied experimentally . . . optically pumped to achieve a sequence non-Boltzmann population distributions, and an interferometric technique is employed to determine refractive index as a function of frequency for each distributions . . .

MODE SELECTION PROPERTIES OF SEGMENTED ROD LASERS
M. Birnbaum, et al., J. Appl. Phys., vol. 34, Nov. 1963, p. 3414/3415, A64-11936.

. . . experiments which demonstrate that segmented-rod lasers, constructed by butting together two or more laser rods with plane-parallel end faces, can considerably reduce the number of axial modes present in the laser output. . . .

PULSED OSCILLATIONS IN RUBY LASERS (Correspondence)
M. Birnbaum, et al., Proc. IEEE, vol. 51, no. 5, May 1963, p. 854/855.

. . . the Statz-de Mars equations are revised into a form more appropriate for the three-level system, solutions of which are found to be in better agreement with the experimental results for ruby lasers. . . .

PROPERTIES OF LASER RESONATORS GIVING UNIPHASE WAVE FRONTS
A. L. Bloom, Spectra-Physics Laser Technical Bulletin, no. 2, Aug. 1963, 7 p., A64-14088.

. . . properties of the hemispherical and other resonators designed specifically for production of uniphase wave fronts. . . . For applications requiring the absolute maximum of power, the large-radius mirror configuration is to be preferred. . . .

THERMAL EFFECTS IN LASER AMPLIFIERS AND OSCILLATORS
A. E. Blume, et al., Applied Optics, vol. 3, April 1964, p. 527/530, 12 refs., A64-16300.

Discussion of the causes and implications of thermally induced optical effects in solid-state laser materials. A convenient interferometric method is described for examining the transient optical phenomena produced by thermal expansion . . . The results obtained with a neodymium laser glass rod are presented photographically.

SPECTRA OF GIANT PULSES FROM A RUBY LASER
D. J. Bradley, et al., Nature, vol. 199, Sept. 1963, p. 1281/1282, A63-25278.

Investigation of the spectral character of a giant pulse emitted by a ruby laser, in order to determine the suitability of this source for plasma light-scattering experiments. . . .

OPTICAL PUMPING
T. R. Carver, Science, vol. 141, Aug. 16, 1963, p. 599/608, 35 refs., A63-22080.

. . . process of redistribution of atoms among their fine- or hyperfine-structure levels by means of light . . . effects of circularly-polarized light on atoms are described. Methods of detecting optical pumping, and, conversely, of using the pumping process as a detector in RF and microwave spectroscopy, are discussed.

CONTROL OF LASER PERFORMANCE
G. E. Danielson, et al., United Aircraft Corp., East Hartford, Conn., Quarterly status rept. no. 1, 26 June-25 Sept. 1963, 14 p., AD 418 981.

. . . Studies of the effect of varying the refractive index of a medium in a laser cavity are being carried out with ultrasonic, electric, or magnetic means. Repetitive pulses have been obtained by the insertion of both liquid and solid ultrasonic refraction shutters in the laser's Fabry-Perot cavity . . . Ultrasonic shear waves induced optically in the ruby laser rod by the laser's pulsating energy were detected.

SEMICLASSICAL TREATMENT OF THE OPTICAL MASER
L. W. Davis, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 76/80.

. . . the steady-state operation of the optical maser oscillator is studied in the case where a single "cavity" mode is excited. . . .

CHARACTERISTICS OF RUBY LASER MODES IN A NOMINALLY PLANE PARALLEL RESONATOR
V. Evtuhov, et al., Hughes Research Labs., Malibu, Calif., In its Laser Devices Exploratory Invest., 1963, p. 30/41, 11 refs., N63-23545.

POWER AND EFFICIENCY CONSIDERATIONS IN CONTINUOUS LASER OPERATION. Appendix—STEADY-STATE EQUATIONS FOR 4-LEVEL LASER
D. R. Frankl., J. Appl. Phys., vol. 34, March 1963, p. 459/462, 12 refs., A63-13799.

Summary of various factors entering into the continuous operation of optically pumped solid-state lasers. Numerical estimates for ruby and for Nd^{+++}-activated materials in two types of optical systems suggest that several watts of output power should, ideally, be obtainable when pumping with a 1-kw Hg arc lamp.

THEORY OF PULSE PROPAGATION IN A LASER AMPLIFIER
L. M. Frantz, et al., J. Appl. Phys., vol. 34, Aug. 1963, p. 2346/2349, A63-20455.

Solution, in closed form, of the photon transport equations describing the growth of a pulse in a laser amplifier. . . .

STIMULATED RAMAN EMISSION IN A NORMAL RUBY LASER (Correspondence)
M. Geller, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1236/1237.

Stimulated Raman emission has been achieved in a number of organic liquids by inserting them in the feedback path of a giant pulse ruby laser. . . . The ruby radiation is present only for about 20 nsec so it is necessary for the IR loop gain to be very high . . . if the IR pulse is to become appreciable. . . . The pulse amplitude increases from essentially zero to full strength (about 5 megw) in less than 1 nsec (the limit of resolution of the detector) . . .

POWER-DEPENDENT SPLITTING OF AXIAL MODES IN RUBY LASERS (Correspondence)
W. Heinlein, et al., Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1667/1668.

. . . it was realized that non-rotational-symmetrical pump-light absorption in a focal-elliptical pumping mirror results in a broadening of the beat bandwidth by deformation of the optical resonator during the pumping pulse. The bandwidth of the beats in such a pumping device was found to be about 20 Mc. In a new pumping device where these effects were eliminated, much smaller bandwidths were found. . . .

THE OPTICAL CHARACTERISTICS OF RUBY LASER EMISSION
M. M. Hercher, Institute of Optics, Univ. of Rochester, N.Y., July 1963, 241 p., AD 423 184.

. . . systematic study of the ruby laser, with an emphasis on the optical characteristics of the laser emission . . .

LASER MATERIALS
R. H. Hoskins, et al., Korad Corp., Santa Monica, Calif., Technical summary rept., 1 April-31 Dec. 1963, 30 Jan. 1964, 1 v., AD 431 998.

CRITERION FOR CONTINUOUS AMPLITUDE OSCILLATIONS OF OPTICAL MASERS
J. I. Kaplan, J. Appl. Phys., vol. 34, Nov. 1963, p. 3411/3412, A64-11935.

Demonstration that a long-time solution having a time-varying amplitude can be obtained for a previously derived set of equations describing a three-level laser self-oscillating between the upper two levels. . . .

PARAMETRIC AMPLIFICATION IN SPATIALLY EXTENDED MEDIA AND APPLICATION TO THE DESIGN OF TUNEABLE OSCILLATORS AT OPTICAL FREQUENCIES
N. M. Kroll, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 110/114.

A theory of travelling-and backward-wave variable parameter amplification appropriate to the amplification of a light beam is developed. . . . applied to the design of a tuneable oscillator at optical wavelengths. . . .

ANALYSIS OF TRANSIENTS AND STABILITY IN AN IDEALIZED TWO-LEVEL LASER SYSTEM
J. E. Ludman, Applied Optics, vol. 2, Aug. 1963, p. 862/863, A63-21177.

. . . Such a two-level system bears resemblance to the diode laser system. It is shown that this two-level laser would achieve a steady-state operation with constant pump rate. . . .

CHARACTERISTICS OF GIANT OPTICAL PULSATIONS FROM RUBY
F. J. McClung, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 46/53.

. . . The pulse characteristics found to date yield information about the nature of various relaxation processes in ruby and point the way to further experiments to clarify many questions which are raised. . . .

THEORY OF PHONON-TERMINATED OPTICAL MASERS
D. E. McCumber, Physical Review, 2nd Series, vol. 134, April 20, 1964, p. A299/A306, 34 refs., A64-17340.

Application of a simple dielectric theory to describe the operating properties of phonon-terminated masers of the type reported by Johnson, Dietz, and Guggenheim. Basic to the model is a broadband gain characteristic which describes the frequency-dependent gain of the active maser material as a function of the populations of metastable electronic levels and of the temperature or temperatures describing lattice vibrations. . . .

MASER ACTION WITHOUT POPULATION INVERSION (Correspondence)
D. Marcuse, Proc. IEEE, vol. 51, no. 5, May 1963, p. 849/850.

It is commonly assumed that population inversion or the existence of a negative temperature is a prerequisite for any maser. This note is intended to show with the help of a specific example that this is not generally true. . . .

LASER Q SPOILING EFFECTS USING A REMOTE REFLECTOR (Correspondence)
J. I. Masters, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 221/223.

. . . techniques for peak power enhancement . . . employ modulation of feedback by shuttering or by rotation of an external reflector and have been referred to as "Q spoiling" . . .

AN EXAMINATION OF THE ABSORPTION, FLUORESCENCE, AND LASER RADIATION SPECTRA FOR SOME COMMERCIAL LASER CRYSTALS
J. G. Meadors, Antenna Lab., Ohio State Univ., Research Foundation, Columbus, Rept. no. 1579 1, 30 Aug. 1963, 27 p., AD 423 567.

In most part, the positions of the energy levels and the gross ranges of laser operating frequencies agree with the published data. But the fluorescense linewidth, the threshold, and the fine characteristics of the lasers deviate considerably. . . .

MOMENTUM TRANSFER AND CRATERING EFFECTS PRODUCED BY GIANT LASER PULSES
F. Neuman, Applied Physics Letters, vol. 4, May 1, 1964, p. 167/169, A64-17747.

Comparison of impacts of giant and normal laser pulses. The giant laser pulse contained approximately 0.3 joules of energy, with a half maximum width of 50 nsec . . . Giant pulses were focused on three different types of materials, and the measured target momenta were tabulated relative to copper . . .

OFF-AXIAL MODE REJECTION OF RUBY LASER USING BALL MIRROR
A. Okaya, Proc. IEEE, vol. 51, no. 7, July 1963, p. 1033/1034.

. . . eliminated the iris and substituted for the spherical concave mirror a spherical convex mirrir of a small diameter. By doing so, we obtained good collimation and high efficiency lasing simultaneously all over the laser rod end surface. . . .

RADIOFREQUENCY BEATS BETWEEN COMPONENTS OF SPLIT AXIAL MODES IN RUBY LASERS (Correspondence)
D. Roess, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1668/1669.

. . . The effect was observed using an optical superheterodyne spectrometer. The amount of the splitting, which was of the order of 1 Mc, should allow the observation of beats between the split components in the output of a photomultiplier into which the laser beam is falling. . . .

RESEARCH ON PROPERTIES OF LASER DEVICES
S. Rothberg (editor), Technical Research Group, Syosset, N.Y., Quarterly technical summary rept. no. 5, June-Aug. 1963, Rept. no. 134QTR5, Aug. 1963, 1 v., AD 421 516.

. . . The study of the stability of several simultaneous modes of oscillation was continued. The limitations on power and efficiency of gas lasers were analyzed. . . .

THE EXCITED STATE-LATTICE INTERACTION OF THE F-CENTER
R. A. Shatas, Army Missile Command, Redstone Arsenal, Huntsville, Ala., Rept. no. RR-TR-63-1, 28 Feb. 1963, 13 p., incl. illus., 21 refs., AD 400 327.

. . . importance of phonon processes in optical maser research, a brief survey of photon and phonon transitions . . . Infrared quenching, photo-conductivity and absorption modulation experiments are outlined for the purpose of testing the metastable state hypothesis.

THEORY OF FOUR LEVEL SOLID STATE LASERS
P. P. Sorokin, Thomas J. Watson Research Center, Yorktown Heights, N.Y., Research rept. RC927, 1 May 1963, 78 p., AD 416 588.

OB INTERFERENTSIONNYKH IAVLENIAKH V LAZERNYKH SISTEMAKH (Interference Effects in Laser Systems) (In Russian)
V. L. Strizhevskii, Optika i Spektroskopiia, vol. 16, Jan. 1964, p. 169/171, 18 refs., A64-15564.

Discussion of some peculiar features of interference effects in lasers, produced by multiple reflections of the light beam. The analysis is based on the assumption of a constant excess population of the upper states. . . .

STEADY-STATE OUTPUT POWER OF A LASER AS A FUNCTION OF THE SINGLE-PASS GAIN
I. Tobias, J. Appl. Phys., vol. 34, Nov. 1963, p. 3200/3204, 10 refs., A64-11922.

AN INVESTIGATION OF PULSED MODES OF LASER OPERATION. PART I. RESEARCH ON A COHERENT ELECTROMAGNETIC RADIATION DEVICE CONFIGURATION
A. Vuylsteke, GM Defense Research Lab., Santa Barbara, Calif., Final rept., July 1962-July 1963, Rept. no. TR63 227, Pt. 1, ASD TDR 63 812, pt. 1, Oct. 1963, 79 p., AD 421 758.

. . . to determine feasibility of the pulsed transmission mode (PTM) of laser operation. . . .

AN INVESTIGATION OF PULSED MODES OF LASER OPERATION. PART II: BEHAVIOR OF A PULSED LASER WITH STEP FUNCTION SWITCHING
A. Vuylsteke, et al., GM Defense Research Labs., Santa Barbara, Calif., Final rept., July 1962-July 1963, Rept. no. TR63 227, pt. 2, ASD TDR 63 813, pt. 2, Oct. 1963, 56 p., AD 421 759.

The conventional coupled laser rate equations are solved for a step-function Q-switched laser to give exact values of peak radiation in the cavity, of residual material population inversion after the radiation in the cavity has decayed, of externally delivered radiant energy, and of the conditions to maximize this energy. . . .

THEORY OF LASER REGENERATION SWITCHING
A. A. Vuylsteke, J. Appl. Phys., vol. 34, June 1963, p. 1615/1622, 10 refs., A64-10921.

. . . The rate equations are derived . . . Using approximate solutions, three modes of laser operation, other than the normal mode, are discussed. . . .

EVOLUTION OF THE GIANT PULSE IN A LASER
W. G. Wagner, et al., J. Appl. Phys., vol. 34, July 1963, p. 2040/2046, A63-18630.

The differential equations governing inversion and photon density in a laser are solved for giant pulse operation. . . .

OPTICAL GIANT PULSES FROM A Q-SWITCHED LASER (Correspondence)
C. C. Wang, Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1767.

. . . purpose of this communication to show that approximate solutions may be obtained for the buildup, the main body and the decay of the giant pulses, respectively. . . .

SPONTANEOUS EMISSION IN LASER AMPLIFIER
W. H. Wells, JPL Space Progr. Summ., vol. 4, no. 37-21, April/May 1963, p. 183/187.

Reviewed as both a noise source and a power loss. The relation between SE and stimulated emission is expressed in terms of gain per unit length. The fundamental noise limit of laser amplifiers is considered along with two practical factors which increase noise above this limit owing to imperfect population inversion and imperfect spatial coherence.

ENERGY AND POWER CONSIDERATIONS IN INJECTION AND OPTICALLY PUMPED LASERS
A. Yariv, Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1723/1731.

DOPPLER LINE SHAPE OF ATOMIC FLUORESCENCE EXCITED BY MODECULAR PHOTODISSOCIATION
R. N. Zare, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 173/182.

In optical masers having a gas as the active medium the pumping mechanisms tried thus far have utilized transitions between atomic energy levels. Many molecular dissociative processes which produce excited atoms are known, however. . . . The conditions required to obtain coherent amplification or oscillation by stimulated emission of the atomic fluorescence line may be determined from the fundamental analysis of Schawlow and Townes. . . . We shall treat the dissociation of a diatomic gas by a beam of light by means of a simple semiclassical model. The main features derived from this will be seen to apply also to other dissociative processes and to polyatomic molecules . . .

LASER DEVICES EXPLORATORY INVESTIGATION
Hughes Research Labs., Malibu, Calif., Interim scientific rept. no. 1, 1 May/31 July 1963, 49 p., AD 417 097.

. . . understanding and attainment of single transverse mode. . . operation in a solid state laser. Application of a mode selection technique to a ruby laser has resulted in a single transverse mode operation at twice threshold pumping with a 15 fold increase in brightness . . . Preliminary experiments on nonlinear optics have demonstrated the generation of Stokes and anti-stokes frequency shifted lines in calcite and benzene . . .

3B.342: Gas Lasers

Included: Parallel gas lasers with common optical cavity; Helium-neon gas laser.

Not Included: Fundamental research on gas lasers.

Cross References: Theory of gas lasers (3B.341).

Principal Publications:

GASEOUS OPTICAL MASERS
W.R. Bennett, Yale U., New Haven, Conn., 27 Sept. 1962, 38 p., AD 412 347.

A detailed review of the present knowledge of gaseous optical masers . . . properties of the normal cavity modes . . . gas systems in which continuous oscillation has been achieved . . . spectral characteristics and mode pulling effects. . . .

RESEARCH ON PROPERTIES OF LASER DEVICES
R. Daly, et al., Technical Research Group, Syosset, N.Y., Quarterly technical summary rept. no. 1, June-Aug 62, Rept. no. TRG-134-QRT-1, Aug. 1962, lv. incl. illus. tables, AD 286 916.

Cesium gas LASERs designed to operate in the milliwatt range at 3 microns and 7 microns have been under construction . . .

LASERS
C. Finnie, et al., JPL Space Progr. Summ., vol. 4, no. 37-19, Dec. 1962, p. 186/187.

The gas laser reported previously (SPS 37-18, Vol. IV) has been improved in such a way that it will oscillate at the 0.633-μ wavelength as well as the 1.15-μ wavelength.

OPTICAL PROPERTIES OF A CONTINUOUS HELIUM-NEON OPTICAL MASER
D.R. Herriott, Appl. Optics, Suppl. 1, 1962, p. 118/124.

ALIGNMENT: CHARACTERISTICS OF A HELIUM-NEON OPTICAL MASER (Correspondence)
J. Killpatrick, et al., Proc. IRE, vol. 50, June 1962, p. 1521.

RESEARCH ON PROPERTIES OF LASER DEVICES
M. Newstein, et al. (editors), Technical Research Group, Syosset, N.Y., Quarterly technical summary rept. no. 2, Sept-Nov. 62, Rept. no. TRG-134-QTR-2, Nov. 1962, lv. incl. illus. tables, 9 refs., AD 292 165.

RESEARCH ON GASEOUS OPTICAL MASER TO DEVELOP HIGH CONTINUOUS WAVE POWER AT OPTICAL WAVELENGTHS
S.E. Sobottka, Watkins-Johnson Co., Palo Alto, Calif., W J62 606R8, 31 Oct. 1962, 17 p., AD 406 930.

He-Ne gas lasers at both 1.15 microns and 6328 angstroms have been successfully operated during the past quarter.

POWER OUTPUT OF THE 6328 Å HELIUM-NEON MASER AS A FUNCTION OF THE RESONANT CAVITY LENGTH (Correspondence)
S.S. Alpert, et al., Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1665/1666.

PULSED HELIUM-NEON GAS LASER APPLICATIONS
L.L. Antes, et al., IEEE Trans. Mil. Electronics, vol. MIL-8, no. 1, Jan. 1964, p. 3/12.

. . . By increasing the size of the laser tube several times, by optimizing the gas ratio and pressure, by optimizing reflectivity and transmissivity of the reflecting mirrors, and by controlling the shape and application of the exciting voltage pulse, peak power outputs in the kilowatt range are theoretically possible. . . . An automatic tracking radar system has been synthesized utilizing the pulsed gas laser as a transmitting component. A brief parametric analysis has been made and some of the advantages of the optical radar over its microwave counterpart have been outlined. . . .

ISSLEDOVANIE VYKHODNOI MOSHCHNOSTI OPTICHESKOGO GENERATORA NA SMESI NEONA I GELIIA OT RAZLICHNYKH PARAMETROV (Investigation of the Output Power of a Neon-Helium Laser as a Function of Various Parameters) (In Russian)
N.G. Basov, et al., Optika i Spektroskopiia, vol. 15, Sept. 1963, p. 436/438, A64-10276.

PROBLEMS RELATED TO HIGH POWER GAS LASER SYSTEMS
W.R. Bennett, Jr., Institute for Defense Analyses, Washington, D.C., July 1963, 69 p., AD 426 961.

. . . It is generally to be expected that the highest output systems will fall at the short wavelength end of the spectrum—although severe complications in these systems may arise from competition by higher gain long-wavelength transitions from the same upper state . . .

OBSERVATION OF INCREASED POWER OUTPUT FROM He-Ne OPTICAL MASER BY MEANS OF EXTERNALLY APPLIED HIGH-VOLTAGE PULSING (Correspondence)
E.H. Byerly, et al., Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 360.

GAS LASER
C. Finnie, et al., JPL Space Progr. Summ., vol. 4, Feb./Mar. 1963, p. 124/125.

The power output of the He-Ne gas laser reported previously . . . has been measured.

DIATOMIC GAS OPTICAL MASER WITH EXPLODING WIRE PUMPING SOURCE
L. Hajdu, Electronics Research Lab., Univ. of California, Berkeley, Rept. no. 63 12, 5 June 1963, 36 p., AD 421 806.

. . . feasibility of a gaseous maser in which the excited atoms are produced through photochemical decomposition of diatomic molecules (such as nitrogen, oxygen and nitric oxide) is studied. . . .

INVESTIGATION OF GAS LASERS AND NONLINEAR OPTICAL EFFECTS
T.S. Hartwick, et al., Aerospace Corp., Los Angeles, Calif., Semiannual tech. note, 1 Jan-30 June 63, Rept. no. TDR169 3250 21TN2, 21 Dec. 1963, 45 p., AD 430 129.

. . . frequency modulation of a gas laser by a time-varying axial magnetic field. . . . Analysis and experimental results show that the 'gain-switching' technique will be very useful for the repeated, reliable production of short, high-power laser pulses needed in the study of nonlinear optical effects and in optical radar.

SOME DEMONSTRATIONS OF THE PROPERTIES OF OPTICAL MASERS
C. Hilsum, et al., Contemporary Physics, vol. 4, Aug. 1963, p. 435/444, A63-24272.

Description of the characteristics and mode of operation of gas discharge and gallium-arsenide semiconductor lasers . . .

LASER MODES
B.F. Hochheimer, et al., APL Technical Digest, vol. 3, Jan.-Feb. 1964, p. 2/8, 15 refs., A64-16317.

Experimental investigation to determine, in a general way, the characteristics of the emission modes of a helium-neon gas laser. . . .

GASEOUS OPTICAL MASERS AND THEIR APPLICATIONS
A. Javan, Massachusetts Inst. of Tech., Cambridge, 1963, 35 p., refs., Presented at the Materials Sci. Colloq., Ithaca, N.Y., 5 Nov. 1963, Submitted for Publication, N64-13929.

. . . A He-Ne system is described that is capable of producing oscillations at a large number of wavelengths. Its range covers a number of transitions in the red-yellow region of the spectrum as well as numerous transitions in the infrared region . . . An optical frequency oscillator is considered which consists of a gaseous discharge tube placed within an optical resonator . . .

LASERS A GAZ (Gas Lasers) (In French)
P. Laures, Ann. Radioelect., vol. 18, no. 71, Jan. 1963, p. 15/48.

. . . condition of operation of a laser . . . width of the emission line obtained . . . lifetime of excited states, methods for enriching a particular state . . . prediction . . . of certain types of operation based essentially on enriching the upper level by collision of the second class . . . calculations have given the necessary enrichment factors as well as the power available.

POLARIZED CHARACTER OF RUBY LASER (Correspondence)
K. Miyaji, et al., Proc. IEEE, vol. 51, no. 6, June 1963, p. 935.

. . . has been observed by some workers . . . In this communication, experimental results and some discussion of the polarized character are described and reasons are discussed. . . .

SOME EXPERIMENTS ON PARALLEL GAS LASERS WITHIN A COMMON OPTICAL CAVITY
R.A. Paananen, et al., Proc. IEEE, vol. 51, no. 7, July 1963, p. 1036/1037.

. . . Radio frequency pumping in the usual 20-30 Mc band was used to excite the plasma at power levels up to 950 watts. . . .

ZEEMAN EFFECTS IN GASEOUS HE-NE OPTICAL MASERS
R. Paananen, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 63/69.

STUDY OF PULSED LASER GENERATION IN NEON AND IN MIXTURES OF NEON AND HELIUM (Translation)
G.G. Petrash, et al., Soviet Physics - JETP, vol. 18, Mar. 1964, p. 571/575, 8 refs., A64-17358.

INTERFEROMETRIC INVESTIGATION OF MODES IN OPTICAL GAS MASERS
Thomas G. Polanyi, et al., J. Opt. Soc. Amer., vol. 54, April 1964, p. 449/454, 17 refs., A64-16564.

RESEARCH ON PROPERTIES OF LASER DEVICES
S. Rothberg (editor), Technical Research Group, Syosset, N.Y., Quarterly technical summary rept. no. 5, June-Aug 63, Rept. no. 134QTR5, Aug. 1963, lv., AD 421 516.

The description of the influence of fluctuations on the laser line shape was initiated. The theory of the Fabry-Perot resonator was extended to include the next correction in order to enlarge the domain of validity to lower Fresnel numbers. The study of the stability of several simultaneous modes of oscillation was continued. The limitations on power and efficiency of gas lasers were analyzed. . . .

GASEOUS OPTICAL MASERS
S.E. Sobottka, et al., Watkins-Johnson Co., Palo Alto, Calif., Rept. for May 62-Nov. 63, Dec. 1963, 75 p., AD 433 961.

. . . Studies . . . of basic processes operating in He-Ne lasers with emphasis on acquiring information related to techniques for increasing the output powers. . . .

APPROXIMATE ELECTROMAGNETIC TRANSITION PROBABILITIES AND RELATIVE ELECTRON EXCITATION CROSS SECTIONS FOR RARE-GAS MASERS
H. Statz, et al., J. Appl. Phys., vol. 34, Sept. 1963, p. 2625/2632, 14 refs., A63-21811.

Calculation of numerical values for the electromagnetic transition probabilities for a large number of rare-gas maser lines. . . .

INCREASED POWER OUTPUT OF THE 6328-Å GAS MASER (Correspondence)
A.D. White, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1669.

DEPENDENCE OF POWER OUTPUT OF A GAS LASER ON THE LENGTH AND RATE OF EXCITATION OF THE DISCHARGE
J.A. White, Applied Physics Letters, vol. 3, Oct. 1, 1963, p. 107/109, A64-13368.

THE ANALYSIS OF LASER OPERATION FROM A MICROWAVE CIRCUIT VIEW POINT
M.R. Wohlers, Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept., July 1963, 15 p. refs., N64-14874.

The linear microwave-circuit theory of lasers is developed by ascribing the microscopic parameters μ and ϵ to lasing material, and then obtaining solutions to Maxwell's equations in the regions of interest. The approach is applied to a plane-wave Fabry-Perot interferometer filled with lasing material, and the threshold conditions for lasing or oscillation are determined. An example is presented which demonstrates the results as applied to a typical He-Ne laser.

3B.343: Ruby Lasers

Included: Ruby optical maser; Solid state (ruby) laser; Flux-grown ruby; Optical laser ruby rods.

Not Included: Fundamentals on laser materials.

Cross References: Theory of laser operations (3B.341); Auxiliary devices for laser operation (3B.347); Measurements of lasers (3B.349).

Principal Publications:

PARAMAGNETIC SPECTRA OF SUBSTITUTED SAPPHIRES—PARI I: RUBY
E.O. Schulz-DuBois, Bell Syst. Tech. J., vol. 38, no. 1, Jan. 1959, p. 271/290.

MASER ACTION IN RUBY BY OFF-RESONANCE PUMPING (Correspondence)
F. Arams, et al., Proc. IRE, vol. 49, Sept. 1961, p. 1426/1427.

SOME OPERATING CHARACTERISTICS OF FLASH-PUMPED RUBY LASERS (Correspondence)
John C. Cook, Proc. IRE, vol. 49, Oct. 1961, p. 1570/1571.

ON THE PROBLEM OF PULSED OSCILLATIONS IN RUBY MASER
George Makhov, Institute of Science and Tech., U. of Michigan, Ann Arbor, Rept. 2900-283-R, Sept. 1961, 10 p., AD 263 339.

PORTABLE RUBY OPTICAL MASER DEMONSTRATED BY THE LABORATORIES
Bell Lab. Record, vol. 39, no. 8, Aug. 1961, p. 280.

. . . which operates on less than one-tenth the input power of standard sized masers was demonstrated by R. J. Collins of Bell Laboratories at the International Conference on Optical Instruments and Techniques in London last month. . . .

EXPERIMENTS ON A PARTIALLY SHIELDED RUBY LASER ROD (Correspondence)
R. L. Aagard, Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2374/2375.

EMISSION PATTERNS OF A RUBY LASER (Correspondence)
E. S. Dayhoff, Proc. IRE, vol. 50, no. 7 July 1962, p. 1684.

OBSERVATIONS ON THE PUMP-LIGHT INTENSITY DISTRIBUTION OF A RUBY OPTICAL MASER WITH DIFFERENT PUMPING SCHEMES (Correspondence)
Tingye Li, Proc. IRE, vol. 50, no. 4, April 1962, p. 464/465.

CONTROL OF RUBY LASER OSCILLATION BY AN INHOMOGENEOUS MAGNETIC FIELD (Correspondence)
H. C. Nedderman, et al., Proc. IRE, vol. 50, no. 7, July 1962, p. 1687/1688.

TIME COHERENCE IN RUBY LASERS (Correspondence)
J. F. Ready, Proc. IRE, vol. 50, no. 7, July 1962, p. 1695/1696.

OPTICAL MASER RESEARCH
J. G. Skinner, et al., Bell Telephone Labs., Inc., Murray Hill, N. J., Quarterly rept. no. 4, 15 Apr-15 July 62, 15 July 1962, 17 p. incl. illus. tables, 7 refs., AD 285 947.

Work on a mode selective interferometer for the purpose of obtaining optical oscillators of large diameter which have diffraction-limited beams . . . The experimental results on a pulsed ruby optical oscillator using this interferometer are presented. . . .

SIDE EMISSION FROM RUBY LASER RODS (Correspondence)
A. Szabo, et al., Proc. IRE, vol. 50, no. 7, July 1962, p. 1690.

RUBY LASER OPERATION IN THE NEAR IR (Correspondence)
E. J. Woodbury, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2367.

In the course of experiments with a pulsed reflector laser of the type described by Hellwarth and McClug, we have observed a stimulated emission at approximately 7670 Å accompanying the usual Å emission. . . .

LOSSES IN A PULSED RUBY LASER
R. L. Aagard, J. Opt. Soc. Amer., vol. 53, Aug. 1963, p. 911/914, 24 refs., A63-21061.

Experimental determination of the total cavity loss in several ruby lasers from a set of threshold measurements. Scattering loss . . . end-mirror reflectance . . . Diffraction loss . . . values are in agreement with theoretical analysis within experimental error.

ELECTRONIC RESEARCH PROGRAM. SELECTION OF OSCILLATION MODES IN OPTICAL MASERS
M. Birnbaum, Aerospace Corp., Los Angeles, Calif., TDR169 3250, 22TR1, SSD TDR63 84, 23 April 1963, 29 p., AD 405 114.

Ruby lasers formed by butting together two laser rods with plane parallel end were shown to possess mode selection properties. The interface between the rubies acts as a partially-transparent reflector.

CONTINUOUSLY PUMPED SOLID STATE OPTICAL MASERS
W. S. Boyle, et al., Bell Telephone Labs., Inc., Murray Hill, N. J., In AGARD, Paris Light and Heat Sensing, 1963, p. 199/206 refs., N64-15467.

HOLE-BURNING MODEL OF OSCILLATION OF RUBY LASER
A. J. DeMaria, et al., Appl. Optics, vol. 2, Aug. 1963, p. 807/810, 12 refs., A63-21167.

Application of a Space Technology Laboratories high-speed image-converter camera to study the time variation of the output radiation from a 15-cm-long ruby laser, the latter being operated with detached external reflectors separated by 61 cm. These data offer additional support for the "hole-burning" model type of oscillation for ruby lasers. . . .

EFFECTS OF γ-IRRADIATION ON THE PERFORMANCE OF A RUBY LASER (Correspondence)
W. Flowers, et al., Proc. IEEE, vol. 51, no. 5, May 1963, p. 858/859.

A significant increase in the efficiency of ruby laser rods was obtained by irradiating the rods with Co^{60} gamma rays. The increase in efficiency seems to be due to a more efficient absorption of the pump light by color centers produced in the ruby by irradiation. The mechanism of energy transfer between the color centers and the laser transition has not yet been determined. . . .

13-INCH RUBY OSCILLATOR-AMPLIFIER CHAIN (Correspondence)
H. G. Heard, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1664.

A 13-inch long, 0.670-inch diameter. 0.05 per cent chromium concentration. 90° ruby has been operated as an image amplifier in an oscillator-amplifier chain.

MAXIMUM GAIN FOR FORWARD AND BACKWARD WAVE OPTICAL MASER AMPLIFIERS
H. Jacobs, et al., Army Electronics Research and Development Agency, Fort Monmouth, N.J., AELRDL TR2375, July 1963, 26 p., AD 418 338.

. . . applied to the ruby optical maser . . .

DISLOCATIONS IN RUBY LASER CRYSTALS
K. Janowski, et al., Aerospace Corp., El Segundo, Calif., July 29, 1963, 34 p., 10 refs., SSD-TDR-63-172, N 63-20668.

RUBY LASER WITH GENERATION DURATION OF ~10 MILLISECONDS (Translation)
V.K. Koniukhov, et al., Soviet Physics - JETP, vol. 18, March 1964, p. 588/591, 8 refs., A64-17360.

Investigation of the spectral composition of a ruby laser within a temperature range of approximately 80° - 100° K operating with a generated pulse duration of approximately 10 msec. The spectrum at low temperatures and with a generated pulse duration of 1 msec consists of two separated components. The complete spectrum was photographed during a single flash and the length of exposure coincided with the duration of the pulse.

CHARACTERISTICS OF RUBY LASERS AT THE TEMPERATURE OF LIQUID NITROGEN (Translation)
V.K. Koniukhov, et al., Soviet Physics - Doklady, vol. 8, Sept. 1963, p. 298/299, A63-21623.

Experimental investigation of the spectral components of the radiation from a ruby laser at 77.4° K, using a Fabry-Perot interferometer. . . . A graph is given showing the ratio between the energies of each of the spectral components as functions of the total generation energy.

ON THE THEORY OF THE PULSATIONS IN THE OUTPUT OF THE RUBY LASER (Translation)
V.V. Korobkin, et al., Soviet Physics - JETP, vol. 18, March 1964, p. 693/697, 12 refs., A64-17361.

. . . Formulas are derived for the amplitudes and frequencies of the spikes as functions of the parameters characterizing the laser. The mechanism of the spiking is the transfer of particles from the upper level to the lower one with the radiation of energy, and in the opposite direction with absorption of energy.

COHERENCE AND TIME SCANNING OF THE EMISSION SPECTRA OF A RUBY LASER (Translation)
V. V. Korobkin, et al., Soviet Physics - JETP, vol. 17, Dec. 1963, p. 1242/1245, 10 refs., A64-13286.

. . . The spectra and beam divergence in separate pulses were studied at -165° C. . . . Time scanning of the generated radiation was carried out with a type SFR fast camera operating as a photorecorder. The scanning shows that, in the individual bursts, generation occurs in several modes having different axial characteristics. . . .

INVESTIGATION OF RUBY OPTICAL MASER CHARACTERISTICS USING MICROWAVE PHOTOTUBES
B. J. McMurtry, Stanford Electronics Labs., Stanford Univ., Calif., 7 Feb. 1963, 20 p., AD 424 371.

. . . application of photoelectric mixing techniques to the study of the ruby laser. . . . extensive experiments are described. . . .

LOSS FACTORS AFFECTING RUBY LASER SYSTEMS
J. Masters, et al., Technical Operations, Inc., Burlington, Mass., Final rept., 31 Jan. 1964, 76 p., AD 437 608.

. . . Studies are reported of the important influence of mode coupling and mode selection upon the threshold condition for oscillation in ruby lasers.

LASER ACTION IN A FLUX-GROWN RUBY
D. F. Nelson, et al., J. Appl. Phys., vol. 35, pt. 1, March 1964, p. 522/529, 30 refs., A64-15825.

A method of growing very perfect ruby crystals . . . is described. . . .

DESIGN SPECIFICATIONS FOR OPTICAL LASER RUBY RODS
N. B. Piper, Jr., Microtecnic, vol. 17, no. 2, 1963, p. 59/63, A63-24172.

Discussion of the practical limits to which the important mechanical and optical parameters of a laser can be controlled by precision fabrication. . . .

OPTICAL QUALITY AND RADIATION PATTERNS OF RUBY LASERS
C. M. Stickley, Appl. Optics, vol. 2, Aug. 1963, p. 855/860, 16 refs., A63-21175.

GIANT RUBY LASER PRODUCES HARMONICS
Electronics, vol. 36, May 10, 1963, p. 60, 62/64, A63-16927.

. . . The laser used has an output energy of 30 millijoules, and a triangular pulse with 60 nanosec. . . .

3B.344: Injection Lasers

Included: Semiconductor lasers; Electron injection laser; Silicon P-N junction light generator; Interaction of coherent light with solids; Gallium-arsenide laser; Tunnel-injection semiconductor lasers; InP lasers; Optotransistors.

Not Included: Solid state physics.

Cross References: Application of lasers (3B.380); Measurements of lasers (3B.349); General theory of lasers (3B.341); Silicon carbide diode laser (3B.348).

Principal Publications:

ELECTRON INJECTION LASER
R. W. Keyes, et al., Thomas J. Watson Research Center, Yorktown Heights, N.Y., Quarterly progress report no. 2, 1 Sept. - 30 Nov. 1962, 30 Nov. 1962, 55 p., incl. illus., tables, refs., AD 297 342.

. . . discovery that lasing action can be attained in electroluminescent p-n junctions. The theory of the spatial recombination in an injection laser and the thermodynamics of electroluminescence are also discussed. (See also AD 289 810.)

RECOMBINATION RADIATION EMITTED BY GALLIUM ARSENIDE (Correspondence)
R. J. Keyes, et al., Proc. IRE, vol 50, no. 8, Aug. 1962, p. 1822/1823.

When appropriately diffused GaAs diodes are biased in the forward direction they emit intense line radiation corresponding to gap transitions. Absolute measurements of the emitted radiation intensity indicate that at 77^{o} K these diodes may be as high as 85 per cent efficient in the conversion of injected holes into photons of the gap energy. . . .

SOLID STATE OPTICAL MASER WORK AT IBM
M. J. Stevenson, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 201.

SEMICONDUCTOR DEVICE CONCEPTS
General Electric Co., Syracuse, N.Y., Scientific rept. no. 2B, 30 Nov. 1962, 10 p., 5 refs., AD 296 197.

Generation of coherent visible radiation in Ga(As1 -xPx) p-n junctions is . . . extension to and implications of p-n junctions lasers in ternary compounds . . . their considerable potential for use as avalanche and forward regulator diodes, signal diodes, parametric diodes, and stored charge diodes are described.

INTERACTIONS OF COHERENT OPTICAL RADIATION WITH SOLIDS
R. Braunstein, et al., RCA Labs. Div. Radio Corp. of America, Princeton, N.J., Semi-annual technical summary rept., 1 May 1963 - 31 Dec. 1963, 31 Dec. 1963, 37 p., AD 431 975.

. . . study of double-photon absorption, harmonic generation in semiconductors, and the frequency tuning of injection lasers by uniaxial stress are reported. . . .

ONSET OF STIMULATED EMISSION FROM GALLIUM ARSENIDE SEMICONDUCTOR OPTICAL MASERS
R. F. Broom, et al., Nature, vol. 198, April 27, 1963, p. 368/369, A63-17681.

Investigation of gallium arsenide junction diodes operated on a heat sink which is conduction-cooled with liguid nitrogen, so that the diode temperature is about 100^{o}K. . . . spectral emission, as recorded by a spectrometer, varies markedly with the current density . . . A partial hypothesis of the bright spots suggests that the current is not distributed uniformly over the area of the junction, and that the local current density is much higher than the mean current density.

THE ONSET OF STIMULATED EMISSION FROM GaAs SEMICONDUCTOR OPTICAL MASERS
R. F. Broom, et al., Services Electronics Research Lab., Bal dock (Gt. Brit.), in its S.E.R.L. Tech. Journal, June 1963, p. 90/92, 2 refs., N63-22258.

. . . The fabrication of gallium arsenide junction diodes, which show signs of coherent emission at current densities as low as 1,500 amps/cm^2 at a diode temperature of about 100^{o}K, is reported . . .

OPTICAL RESEARCH AND THE SOLID STATE LASER
J. M. Burch, J. Sci. Instrum., vol. 40, April 1963, p. 147/152, 20 refs., A63-16636.

LINE SHAPE IN GaAs INJECTION LASERS (Correspondence)
G. Burns, et al., Proc. IEEE, vol. 51, no. 3, March 1963, p. 471/472.

THE EFFECT OF TEMPERATURE ON THE PROPERTIES OF GaAs LASER (Correspondence)
G. Burns, et al., Proc. IEEE, vol. 51, no. 6, June 1963, p. 947/948.

. . . the effect of temperature on the Fabry-Perot modes, threshold current density, and CW operation is reported. . . .

SOME PROPERTIES OF InP LASERS (Correspondence)
G. Burns, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1148/1149.

. . . more extensive measurements on InP lasers are reported. The results confirm that the stimulated emission in InP behaves quite similarly to GaAs. . . .

DYNAMIC MEASUREMENT OF THE PIEZOELECTRIC AND ELASTIC CONSTANTS OF GALLIUM ARSENIDE (Correspondence)
E. J. Charlson, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1239.

Recent research in electrical-acoustical interaction has prompted an interest in the piezoelectric properties of GaAs. . . .

EXPERIMENTS ON OPTICAL COUPLING BETWEEN GaAs P-N JUNCTION AND HETEROJUNCTION (Correspondence)
F. F. Fang, et al., Proc. IEEE, vol. 51, no. 5, May 1963, p. 860.

SPATIAL DISTRIBUTION OF RADIATION FROM GaAs LASERS
G. E. Fenner, et al., J. Appl. Phys., vol. 34, Nov. 1963, p. 3204/3208, 16 refs., A64-11923.

. . . having Fabry-Perot resonators. In general, the diodes emit several fan-shaped beams of comparable magnitude at angles up to 10° with respect to the normal of the mirrors in the junction plane. . . .

SUM FREQUENCIES AND HARMONIC GENERATION IN GaAs LASERS
M. Garfinkel, et al., Applied Physics Letters, vol. 3, Nov. 15, 1963, p. 178/180, A64-13342.

PHOTRONICS: THE GENERATION OF LIGHT IN SILICON P-N JUNCTIONS AND THE OPTICAL COUPLING OF SEMICONDUCTOR DEVICES
M. A. Gilleo, Amelco, Inc., Mountain View, Calif., Final rept., ASD TDR 63 606, July 1963, 104 p., AD 413 909.

Silicon p-n junctions coupled by a light pipe were evaluated as a means for the generation, transmission, and reception of photons which would serve to transfer an electrical signal from one circuit to another without electrical interconnection. . . .

LIGHT EMISSION FROM SILICON TRANSISTOR JUNCTIONS (Correspondence)
E. B. Hakim, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1155/1156.

SEMICONDUCTOR DEVICE CONCEPTS
R. N. Hall, General Electric Co. Research Lab., Schenectady, N.Y., Scientific Report No. 3A, AFCRL-63-120(A), 28 Feb. 1963, 64 p., 28 refs., N63-18913.

A theoretical analysis of the threshold current density and carrier distribution in junction lasers has been carried out.

TUNNEL-INJECTION SEMICONDUCTOR LASERS
R. V. Hanks, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 169/173.

SOME DEMONSTRATIONS OF THE PROPERTIES OF OPTICAL MASERS
C. Hilsum, et al., Contemporary Phys., vol. 4, Aug. 1963, p. 435/444, A63-24272.

. . . operation of . . . gallium-arsenide semiconductor lasers. . . .

LIGHT EMISSION FROM ALLOYED JUNCTION GALLIUM ARSENIDE TUNNEL DIODES (Correspondence)
G. J. Hoover, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1237/1238.

Infrared radiation from forward-biased, alloyed junction, gallium arsenide tunnel diodes has been observed and measured. . . . Of particular significance, in the results presented, is the unusual variation of radiant emittance with diode current.

DONOR-DIFFUSED GALLIUM ARSENIDE INJECTION LASERS (Correspondence)
C. E. Kelly, Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1239/1240.

Acceptor diffusions into n-type GaAs do not present as difficult a problem as do donor diffusions into p-type material. . . . In this letter we report the fabrication of n on p GaAs injection lasers by diffusion of donors into a p-type substrate. . . . the exception that the stimulated emission is of a slightly shorter wavelength than is normally observed in conventional units. . . .

ELECTRON INJECTION LASER
R. W. Keyes, et al., Thomas J. Watson Research Center, Yorktown Heights, N.Y., Final rept., 1 June 1962 - 31 May 1963, Rept. no. 4, 31 May 1963, 96 p., AD 413 938.

. . . attempts to incorporate rare earth and transition elements into GaAs and InP, in the hope of stimulating light emission originating form transitions in the f- and d-shells respectively. No such transitions were observed, however. . . . development of an InP injection laser, and . . . crowned with success. . . . properties . . . very similar to those of GaAs lasers, and it is not clear at the moment which compound is more promising for laser applications. Interesting electrical and optical properties were discovered in GaAs diodes . . . electro-luminescent, and exhibit a negative resistance . . . below about 120°K. (See also AD 403 130.)

DOPING OF SEMICONDUCTORS FOR INJECTION LASERS (Correspondence)
R. W. Keyes, Proc. IEEE, vol. 51, no. 4, April 1963, p. 602.

. . . thermodynamic condition for stimulated emission in a semiconductor developed by Bernard and Duraffourg places a restriction on the doping levels required for a lasing junction. The condition is qualitatively apparent. . . . This note puts the requirement of heavy doping on a quantitative basis . . .

A PROPOSED CLASS OF HETEROJUNCTION INJECTION LASERS (Correspondence)
H. Kroemer, Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1782/1783.

Laser action in semiconductors has so far been reported only for direct-gap semiconductors . . . but not yet for indirect gap materials such as Ge, Si and GaP. . . . We propose that laser action chould be obtainable in many of the indirect gap semiconductors, and improved in the direct gap ones, if it is possible to supply them with a pair of heterojunction injectors. These should consist of heavily doped semiconductor layers with a higher energy gap than the radiating semiconductor and ideally should be of opposite polarity. . . .

INJECTION LASER STUDY
G. J. Lasher, et al., T. J. Watson Research Center, Yorktown Heights, N.Y., Quarterly progress rept. no. 2, 1 Sept. - 30 Nov. 1963, 30 Nov. 1963, 58 p., AD 430 696.

A bistable device, whose two stable states are a lasing state and a state with only spontaneous emission . . . was shown to be feasible. . . . (See also AD 422 389.)

SEMICONDUCTOR LASERS
B. Lax, Science, vol. 141, Sept. 27, 1963, p. 1247/1255, 23 refs., AD 427 634, A63-24208.

. . . physical and optical properties of typical gallium arsenide diodes developed for low-temperature operation. . . .

ELECTRONIC AND MUTUAL COMPONENTS OF STIMULATED EMISSION IN LASERS
G. F. Lewin, J. Electronics and Control, First Series, vol. 16, Jan. 1964, p. 21/28, 10 refs., A64-13432.

Evaluation of the perturbation energy between the magnetic field of incident electromagnetic radiation and a laser electron. It is shown that the energy is small. A wave-mechanical treatment of laser action is given for the electric field perturbation, and, from this, an expression is obtained for the emission or negative absorption coefficient which is in agreement with the calculation of Karplus and Schwinger (1948). . . .

TIME CHARACTERISTICS OF LIGHT PULSES FROM GALLIUM ARSENIDE LASERS
J. Lytollis, et al., Nature, vol. 199, Sept. 14, 1963, p. 1083/1085, A63-24115.

INTERNAL SECOND-HARMONIC GENERATION IN GALLIUM ARSENIDE LASERS
L. D. Malmstrom, et al., J. Appl. Phys., vol. 35, Jan. 1964, p. 248/249, A64-14055.

Description of observations of second-harmonic radiation self-induced in a gallium arsenide laser by the intense electric fields at the junction when operating at 0.846μ . . . The lasers were operated at liquid-nitrogen temperature and yielded peak pulse powers up to 20 watt at 100 amp with a pulse width of 5 μ sec. and repetition rate of 13 cps. . . .

GaAs LASER MATERIALS STUDY
G. Mandel, et al., Thomas J. Watson Research Center, Yorktown Hieghts, N. Y., Semi-annual technical summary rept. no. 1, 1 June - 31 Dec. 1963, 31 Dec. 1963, 64 p., AD 428 204.

GALLIUM ARSENIDE INJECTION LASERS
J. Maserjian, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec. 1963, p. 125/127.

. . . test procedures have been modified and stimulated emission has been observed. Some of the properties of the laser performance and its relation to heating effects are described.

INJECTION LASER
J. Maserjian, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 125/126.

. . . may be electrically modulated at microwave frequencies which makes them particularly adaptable to applications in space communications. The device . . . offers possibilities in optical switching . . . In view of the exceptional performance described above, it is appropriate to state some of the possible limitations of the device.

GALLIUM ARSENIDE INJECTION DIODE
J. Maserjian, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 215/218.

. . . previous report (SPS 37-20, Vol. IV) . . . Work has proceeded on fabricating and studying gallium arsenide injection diodes. The negative resistance required for stimulated emission has been observed, but laser action has not yet been proven.

TEMPERATURE LIMITATION ON CONTINUOUS OPERATION OF GaAs LASERS
S. Mayburg, J. Appl. Phys., vol. 34, Nov. 1963, p. 3417/3418, A64-11938.

Demonstration that it is possible to determine whether a GaAs laser will run continuously at a given heat sink temperature T if the threshold current density corresponding to T is known. The results indicate that the continuous operation of GaAs lasers at room temperature is unlikely.

METAL CONTACT DOUBLE INJECTION IN GaAs (Correspondence)
C. A. Mead, Proc. IEEE, vol. 51, no. 6, June 1963, p. 954/955.

GALLIUM ARSENIDE ELECTROLUMINESCENT AND LASER DIODES
H. T. Minden, Semiconductor Prod., vol. 6, Aug. 1963, p. 34/48, 41 refs., A63-21056.

Review of the theory of junction electroluminescence and of diode laser theory. . . .

INJECTION LASERS: STATE OF THE ART
M. I. Nathan, et al., Electronics, vol. 36, Dec. 6, 1963, p. 61/65, 28 refs., A64-11684.

Description of the principles of operation and properties of a laser that skips the intermediate step of optical pumping and converts dc power directly into coherent light. The injection lasers are thus more efficient and compact, and offer attractive possibilities for internal modulation, so they should be useful in the communication field. Other advantages include power conversion efficiency, observed in excess of 50%, and CW output power surpassing that of any other existing laser.

A NEW GaAs LASER THAT CAN BE PUMPED ELECTRICALLY
J. I. Pankove, Radio Corp. of America, Princeton, N. J., In RCA, Camden, N.J., Lasers (1963) 28 p., N64-12569.

. . . is comprised of a p-n junction diode in a wafer of gallium arsenide. The gallium arsenide was converted into a laser by altering its shape, by decreasing the contact resistance to reduce losses, and by increasing the current density through the junction.

CONTINUOUS STIMULATED EMISSION FROM GaAs DIODES AT 77°K (Correspondence)
M. Pilkuhn, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1243.

A study was undertaken for preparing low threshold GaAs laser materials. Optimum results were obtained by using boat grown GaAs . . .

A RELATION BETWEEN THE CURRENT DENSITY AT THRESHOLD AND THE LENGTH OF FABRY-PEROT TYPE GaAs LASERS (Correspondence)
M. Pilkuhn, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1243/1244.

SEMICONDUCTOR LASERS
T. M. Quist, Internat. Science and Technology, Feb. 1964, p. 80/86+, A64-14551.

THE EFFECT OF UNIAXIAL STRAIN ON THE THRESHOLD CURRENT AND OUTPUT OF GaAs LASERS
F. M. Ryan, et al., Applied Physics Letters, vol. 3, Nov. 1, 1963, p. 162/163, A64-13354.

. . . in order to construct a readily tunable laser. . . when the diode was operated as a laser, the output jumped from one mode to another as the pressure was increased, in a fashion similar to that observed with hydrostatic pressure. The laser threshold current always decreased upon the application of uniaxial pressure, . . .

ABSOLUTE MEASUREMENT OF GaAs DIODES RADIATION USING SOLAR CELLS (Correspondence)
E. J. Schiel, et al., Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1780/1781.

The recent discovery of recombination radiation emitted by GaAs diodes has stimulated the interest in absolute power measurements of this radiation. . . .

SPECTRAL CHARACTERISTICS OF GaAs LASERS OPERATING IN "FABRY-PEROT" MODES
P. P. Sorokin, et al., J. Appl. Phys., vol. 34, Sept. 1963, p. 2553/2556, A63-21808.

SOME THEORETICAL ASPECTS OF A PROPOSED DOUBLE QUANTUM STIMULATED EMISSION DEVICE
P. P. Sorokin, et al., IBM J. Res. Developm., vol. 8, April 1964, p. 177/181, 9 refs., A64-17607.

. . . a proposed coherent light generator that makes use of double quantum-stimulated emission. The laser consists of a crystal containing two species of fluorescent ions of which one serves as the active ion in a four-level conventional laser geometry. The ends of the crystal are polished into plane or hemispherical surfaces. Stimulated emission involving the active ion species occurs in the conventional manner. . . the excitation of the non-active ion results in the emission of giant pulses. Several combinations of different ion species and transitions are considered for this type of laser.

GaAs LASER MATERIALS STUDY
W. J. Turner, et al., T. J. Watson Research Center, Yorktown Heights, N. Y., Semi-annual technical rept. no. 1, 1 June - 31 Dec. 1963, 31 Dec. 1963, 44 p., AD 428 208.

MAXIMUM PULSE REPETITION RATE FOR AN INJECTION LASER (Correspondence)
V. Uzunoglu, et al., Proc. IEEE, vol. 51, no. 6, June. 1963, p. 960.

. . . The RC time constant of these devices is typically in the Gc range and the limitation on the pulse repetition rate is determined by the thermal properties of the junction. . . .

PROPOSAL FOR A TWO-STAGE SEMICONDUCTOR LASER THROUGH TUNNELING AND INJECTION
S. Wang, J. Appl. Phys., vol. 34, Dec. 1963, p. 3443/3450, 29 refs., A64-11996.

ENERGY AND POWER CONSIDERATIONS IN INJECTION AND OPTICALLY PUMPED LASERS
A. Yariv., Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1723/1731.

. . . Both three- and four-level lasers are considered in the pulsed and continuous modes of operation. The theoretical power and energy estimates are compared, when possible, with experimental data. . . . This paper is intended primarily as a tutorial review . . .

THE FREQUENCY RESPONSE OF OPTOTRANSISTORS (Correspondence)
H. N. Yu, Proc. IEEE, vol. 51, no. 6, June 1963, p. 945/946.

Optoelectronic semiconductor transistors have been proposed and realized successfully since the discovery of the highly efficient light source using radiative recombination of injected minority carriers in GaAs. The purpose of this note is an attempt to show the limit of the frequency response in such a transistor as compared to that of a conventional bipolar transistor. . . .

STUDY OF NOISE IN SEMICONDUCTOR DEVICES
Minnesota U., Minneapolis, Quarterly rept. no. 1, 1 Aug. - 30 Nov. 1963, 30 Nov. 1963, 1 v., AD 436 874.

Equipment for stabilizing the operating point of FET's and for pulsing GaAs lasers has been built. Noise measurements on Crystalonics FET's at low temperature revealed an excess noise that is not of the generalization-recombination types. . . .

SEMICONDUCTOR INJECTION LASERS
Standard Telecommunications Labs. (Gt. Brit.), Annual Progress rept., Aug. - Dec. 1963, Dec. 1963, p. 15, AD 431 707.

Related Publications:

PULSE MODULATION OF GALLIUM ARSENIDE INJECTION LUMINESCENT DIODE LASER (Correspondence)
J. P. Quine, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1141/1142.

Modulation at 200 Mc has been demonstrated using a gallium arsenide injection luminescent junction diode radiating incoherent light. The present correspondence reports on pulse modulation of gallium arsenide laser diodes operated at current levels above threshold for stimulated emission. The principal factor which limits modulation performance arises from heat generated electrically in the diode. . . .

3B.347: Auxiliary Components and Subsystems for Laser Operation

Included: Laser pumping systems; Focused side pumping; Mirror configuration; Electro-optical shutters; Laser head configurations; Laser cavities; Multi-elliptical cavity; Internal reflection prisms for lasers; Optical beam steering techniques; Spinning reflector technique; Condensers; Resonators.

Not Included: Refrigeration systems.

Cross References: Optical components and subsystems (3B.330).

Principal Publications:

A TOTAL-REFLECTION SOLID-STATE OPTICAL-MASER RESONATOR (Correspondence)
L. Bergstein, et al., Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1833.

. . . a novel resonator and output coupling configuration . . . uses total internal reflection to reflect the light beam and frustrated total reflection for output coupling. . . .

A HIGH-ENERGY LASER USING A MULTI-ELLIPTICAL CAVITY (Correspondence)
C. Bowness, et al., Proc. IRE, vol. 50, no. 7, July 1962, p. 1704/1705.

EFFICIENCY OF A MULTIPLE ELLIPSES CONFOCAL LASER PUMPING CONFIGURATION (Correspondence)
D. L. Fried, et al., Proc. IRE, vol. 50, no. 12, Dec. 1962, p. 2489.

. . . optical pumping system which would make use of several light sources and several truncated elliptical cylinders, all sharing a common focus which would contain a laser rod. . . .

USE OF ELECTRO-OPTICAL SHUTTERS TO STABILIZE RUBY LASER OPERATION (Correspondence)
F. R. Marshall, et al., Proc. IRE, vol. 50, no. 10, Oct. 1962, p. 2108.

EFFECT OF MIRROR ALIGNMENT IN LASER OPERATION (Correspondence)
J. F. Ready, et al., Proc. IRE, vol. 50, no. 12, Dec. 1962, p. 2483/2484.

FOCUSED SIDE PUMPING OF LASER CRYSTAL (Correspondence)
K. Tomiyasu, Proc. IRE, vol. 50, no. 12, Dec. 1962, p. 2488/2489.

. . . In the present paper only focused side pumping is considered as found, for example, in an elliptical configuration. . . .

OPTIMIZATION OF THE PARAMETERS OF MULTI-ELLIPTICAL LASER HEAD CONFIGURATIONS
J. A. Ackerman, Proc. IEEE, vol. 51, no. 7, July 1963, p. 1032/1033.

The present analysis attempts to look more closely at the "imaging" characteristics of an elliptic cylinder . . .

THE SPINNING REFLECTOR TECHNIQUE FOR RUBY LASER PULSE CONTROL
R. C. Benson, et al., IEEE Trans. Mil. Electronics, vol. MIL-8, no. 1, Jan. 1964, p. 13/21.

A method of obtaining high peak power pulses from a ruby laser oscillator by controlling the resonant cavity Q with spinning reflector technique is described. . . . A theory regarding the multiple pulse problem of slow Q switching is presented. Practical methods of eliminating critical alignment procedures and increasing effective switching speed are explained. . . .

HIGH INTENSITY PUMP FOR OPTICAL LASERS
G. L. Clark, et al., Electro-Optical Systems, Inc., Pasadena, Calif., Final rept., 1 July 1962 - 1 April 1963, Rept. no. 3270, ASD TDR 63 651, Aug. 1963, 113 p., AD 416 024.

. . . development, construction, and testing of a laser head in which the source of pump radiation is the dense hot plasma produced by electrically exploded wires . . .

A HIGH-ENERGY LASER USING A MULTI-ELLIPTICAL CAVITY (Correspondence)
H. Z. Cummins, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 254/255.

Bowness, Missio, and Rogala discussed the use of multi-elliptical focusing structures with a single common axis for laser-pumping optics. . . . We . . . have evaluated the increase in efficiency obtainable with various geometries. . . . analysis appears to be in disagreement with the conclusions of Bowness, et al. . . .

APPLICATION OF TOTAL INTERNAL REFLECTION PRISMS FOR GASEOUS LASERS (Correspondence)
Z. Godzinski, Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 361.

One of the most difficult problems in the construction of gaseous lasers consists in very small mirror alignment tolerances . . . can be avoided by using total internal reflection corner prisms . . . instead of mirrors. . . .

DESIGNING LASERS WITH PUMP-POWER CHARTS
R. A. Kaplan, Electronics, vol. 36, Dec. 27, 1963, p. 23/28, A64-13593.

. . . relates pump power, wavelength, and propagation direction of a laser. As a first step, the modes of the resonator are plotted on a mode chart in terms of the direction of propagation and of the resonant wavelength of the plane waves comprising those modes. . . .

A NEW CONDENSER FOR A SUN-POWERED CONTINUOUS LASER
P. H. Keck, et al., Appl. Optics, vol. 2, Aug. 1963, p. 827/831, A63-21171.

. . . to concentrate sunlight effectively from a parabolic collector into a laser rod. . . .

COHERENT OPTICAL BEAM STEERING TECHNIQUES
L. W. Procopio, et al., Philco Corp., Blue Bell, Pa., Final rept., 27 Dec. 1962 - 15 Sept. 1963, RADC TDR 63 450, vol. 1, Jan. 1964, 103 p., AD 428 203.

The technical problems involved in achieving an electronically scanned coherent optical phased array are examined in detail. . . . including studies of coherent optical components, optical losses, limitations imposed by propagation effects, and radiation patterns generated by laser elements . . . Techniques to achieve both electronic steering of a single laser beam and a phased array of lasers are analyzed. . . .

COHERENT OPTICAL BEAM STEERING TECHNIQUES
L. W. Procopio, et al., Philco Corp., Blue Bell, Pa., RADC TDR63 450, vol. 2, Jan. 1964, 209 p., AD 428 670.

EXFOCAL PUMPING OF OPTICAL MASERS IN ELLIPTICAL MIRRORS
D. Roess, Appl. Optics, vol. 3, Feb. 1964, p. 259/265, 11 refs., A64-14260.

THE CONSTRUCTION OF A HELIUM-NEON VISIBLE LASER
D. C. Sinclair, Institute of Optics, Univ. of Rochester, N.Y., 1963, 13 p., AD 437 650.

OPEN RESONATORS FOR LASERS (Translation)
L. A. Vainshtein, Soviet Physics - JETP, vol. 17, Sept. 1963, p. 709/719, 17 refs., A63-22790.

Development of a theory of natural vibrations for resonators consisting of sections of circular or plane waveguide or formed by plane parallel mirrors of rectangular or circular shape. . . . Resonators of these types are of interest for lasers, and also for the physics and technology of millimeter and submillimeter waves.

Related Publications:

CONTINUOUSLY PUMPED SOLID STATE OPTICAL MASERS
W.S. Boyle, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 194/200.

3B.348: Other Types Lasers

Included: Ettinghausen semiconductor laser; Laser excited by nuclear heat; UV exciton laser; Quartz ultraviolet lasers; Quartz optical phonon laser; Toroidal ruby lasers; Neodymium laser; Gatling-gun laser; Glass lasers; Aromatic organic laser; Fabry-Perot laser; Silicon carbide diode laser.

Not Included: General theory of semiconductors.

Cross References: Ultraviolet communications links (3B.473); Fabry-Perot interferometer (3B.349).

Principal Publications:

LIQUID LASER RESEARCH
M. W. Windsor, Space Technology Labs., Inc., Redondo Beach, Calif., Semi-annual progress rept. no. 4, 7 March - 15 Oct. 1962, Rept. no. 8657-6004-RU000, SSD TDR 62-180, 31 Oct. 1962, 58 p., incl. illus., tables, 40 refs., AD 291 592.

Results highly suggestive of laser action have been obtained for benzophenone and a chelate of terbium in rigid organic glasses at 77 K. . . .

RESONANCES OF THE FABRY-PEROT LASER
S. R. Barone, J. Appl. Phys., vol. 34, April 1963 (Part I), p. 831/843, 10 refs., A64-10604.

Investigation of the optical mode structure of a Fabry-Perot interferometer-resonator composed of two infinite strip mirrors, from the point of view of the general theory of non-spectral resonances. It is shown that the classical description of this configuration is inadequate to describe its response to highly monochromatic laser radiation and must be supplemented by a discussion of the transverse resonance behavior. This introduces a fine structure to the classical Fabry-Perot interferometer . . . In the common domain of validity these results are in excellent agreement with previous numerical work on this problem.

QUARTZ ULTRAVIOLET LASERS (Correspondence)
C. H. Becker, et al., Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 358/359.

In the course of quartz optical phonon-maser research we have observed stimulated emission of ultraviolet and violet optical photons in quartz. . . .

QUARTZ ULTRAVIOLET LASERS
C. H. Becker, IEEE Internat. Conv. Rec., vol. 11, no. 3, March 1963, p. 75/78.

. . . stimulated emission of certain ultraviolet optical photons occurs in quartz in conjunction with second-order inelastic (Raman) scattering of light. Second-order ultraviolet light amplification takes place at certain Anti-Stokes frequencies of the ultraviolet pumping light. Optical phonon-maser action at Teracycle frequencies precedes second-order ultraviolet photon-laser action in quartz. . . .

HAIR-TRIGGER OPERATION OF A NEODYMIUM LASER
Naval Ordnance Lab., White Oak, Md., NOL TR 64 32, 4 March 1964, 74 p., AD 436 893.

. . . provides a preselected number of laser bursts at controlled intervals, by shaping the output of the optical pump light in a suitable manner. . . . The working model provides up to three 15 microsecond laser bursts per firing, while the time between bursts is controlled by preselected delays of from 50 to 500 microseconds. The peak power output is several kilowatts. . . .

UV EXCITON LASER (Correspondence)
E. L. Fink, et al., Proc. IEEE, vol. 51, no. 6, June 1963, p. 951.

The rate of spontaneous emission of radiation varies as the cube of the optical frequency. This fact can explain the lack of extensive achievement of UV laser emission. . . . to investigate the theoretical possibility of stimulating UV laser oscillation from exciton levels in pure KI. Due to the occurrence of a Stokes shift, the actual pumping shceme that would be used in KI would consist of four levels. . . .

SILICON CARBIDE DIODE LASER (Correspondence)
L. B. Griffiths, et al., Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1374/1376.

We have observed stimulated emission from forward-biased p-n junctions in α-SiC fabricated by a novel solution growth technique . . . The emission peaks at 4560 A . . . with a linewidth which is less than 5 A (resolution limit of the spectrometer). Continuous operation has been observed at room temperature above threshold current densities as small as 120 amp/cm^2. Spatial coherence of the radiation has been established by photographic evidence of constructive interference. . . .

SILICON CARBIDE DIODE "LASER"
R. N. Hall, General Electric Co., Schenectady, N.Y., In its Semicond. Device Concepts, 31 Oct. 1963, p. 47/58, refs., N64-13750.

Luminescence form traveling solvent SiC diodes is discussed. It is concluded that the narrow emission line which has been reported is due to the spontaneous recombination of bound excitons and is unrelated to coherent light emission.

A LASER EXCITED BY NUCLEAR HEAT
F. M. Johnson, Nucleonics, vol. 22, April 1964, p. 57/60, 13 refs., A64-15878.

Description of a method for the direct conversion of heat from nuclear fuel to coherent monochromatic optical radiation using a laser excited by an arc-mode-type gas discharge across a thermionic diode. In the method proposed, heat from a nuclear fuel is trans-ferred to a cathode which causes electrons to be thermally emitted in a gas diode operated in the low-voltage, or arc-mode regime. The gas cell is so constructed as to consitute the laser itself. . . .

SOLID STATE LASER EXPLORATIONS
Z. J. Kiss, et al., RCA Labs. Div., Radio Corp. of America, Princeton, N. J., Interim engineering rept. no. 1, 15 Oct. 1963 - 15 Jan. 1964, 1 Feb. 1964, 49 p., AD 435 158.

Studies of the excitation of trivalent rare earth ion lasers by cross-pumping in absorption bands associated with color centers in the host crystal were made using ErOf-CaF2. . . . variation of wavelength and line width with temperature . . . Frequency shifts of fluorescence and laser output with excitation level were correlated with thermal tuning effects, and threshold measurements with part of the laser crystal shielded were used to gain insight into basic processes.

GLASS LASER RESEARCH
T. C. MacAvoy, et al., Corning Glass Works, N.Y., Semiannual technical rept., July - Dec. 1963, 30 Jan. 1964, 24 p., AD 431 753.

. . . properties of a soda-lime-silicate laser glass known as Code 0580 glass are reported. . . . Laser damage experiments performed by Westinghouse on 17 different kinds of Corning glass, selected for their unique properties, were analyzed. . . . A new technique was developed to measure thresholds using constant spectral and temporal pump light.

ON THE FEASIBILITY OF AN ETTINGSHAUSEN SEMI-CONDUCTOR LASER
H. Mette, et al., Army Electronics Research and Development Agency, Fort Monmouth, N.J., AELRDL TR 2374, June 1963, 10 p., AD 413 364.

The possibility of achieving stimulated recombination radiation in a semiconductor by an alternate method to the injection diode is investigated. The results show that an excess concentration of recombination carriers sufficient to initiate laser action may be obtained in semiconductors by drift and deflection in a magnetic field (Ettingshausen effect). . . . The design of a possible Ettingshausen laser is discussed in detail and problem areas for future work are listed.

STIMULATED EMISSION IN CaF_2: Er^3 (Correspondence)
S. A. Pollack, Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1793/1794.

. . . at temperatures close to that of liguid nitrogen with an input energy of about 1000 joules. . . .

TOROIDAL RUBY LASERS (Correspondence)
D. Ross, Proc. IEEE, vol. 51, no. 3, March 1963, p. 468/469.

. . . We have experimented with a new resonant structure where mode selection, cavity Q, and coupling in outward direction are rather independent and can be controlled separately. The structure is a torid of laser material with refractive index greater than 1, where stimulated emission is traveling around the axis of the toroid under total reflection. . . .

NEODYMIUM GLASS LASER
E. Snitzer, American Optical Co., Southbridge, Mass., 1962, 23 p., 8 refs., Presented at the Third Intern. Symp. on Quantum Electronics, Paris, Feb. 1963, N63-18148.

. . . in high power and in fiber configurations . . . results . . . of recent experiments on spectral pumping efficiency . . .

GATLING-GUN LASER - NOVEL APPROACH TO OPTICAL RADAR
M.E. Wolff, Electronics, vol. 36, Sept. 20, 1963, p. 25/29, A64-10783.

. . . a new technique for achieving high laser pulse repetition frequencies. . . . involves sequential Q-switching of an array of lasers by a rotating Fabry plate, much in the fashion of the old-time Gatling gun. The result of the technique is to combine the pulse recurrence frequencies (prfs) of several laser beams along identical paths, thus achieving higher prfs than can be obtained with a single crystal. . . .

AROMATIC ORGANIC LASER DEVELOPMENT
General Electric Co., Syracuse, N.Y., Semi-annual rept., 1 July - 31 Dec. 1963, 31 Dec. 1963, 51 p., AD 429 409.

. . . to produce coherent stimulated emission in the blue-green region in a purely organic dopant and host system. . . . The theoretical analysis indicates that the short lived four-level flourescent compounds are the most suitable materials for this purpose. . . . Some gain at 4710 Angstroms in a Fabry-Perot resonant cavity was observed . . .

Related Publications:

MAXIMUM GAIN FOR FORWARD AND BACKWARD WAVE OPTICAL MASER AMPLIFIERS
H. Jacobs, et al., Army Electronics Research and Development Agency, Fort Monmouth, N. J., AELRDL TR2375, July 1963, 26 p., AD 418 338.

. . . analysis . . . of the mechanism of amplification in a device consisting of three media. The first medium . . . air, the second . . . a crystal having a specific dielectric constant and distributed negative conductivity of constant value, and the third medium air . . . applied to the ruby optical maser . . .

3B.349: Measurements on Lasers and Coherent Light

Included: Calibration of laser output; Determination of laser line bandwidth; Spectroscopy of laser emissions; Light intensity measurements; Measurement of beam cross section; Measurements of optical harmonics; Noise measurements in laser beams.

Not Included: Optical instruments.

Cross References: Measurements of millimeter waves (3B.290).

Principal Publications:

OPTICAL HARMONIC FREQUENCY RATIO MEASUREMENTS (Correspondence)
I.D. Abella, Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1824/1825.

. . . The harmonics were generated by fucusing the output of a cooled pulsed-ruby source, estimated at several joules, onto a KDP crystal, at 45° to X-Y axes and normal to the Z axis. . . .

A METHOD FOR CALIBRATION OF LASER ENERGY OUTPUT (Correspondence)
A.L. Glick, Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1835.

. . . especially applicable at low energy output, i.e., near threshold. . . .

MEASUREMENTS OF THE LASER OUTPUT (Correspondence)
S. Koozekanani, et al., Proc. IRE, vol. 50, Feb. 1962, p. 207.

AN INTERFEROMETRIC-MODULATION ORDER-SEPARATOR FOR A FAR INFRARED SPECTROGRAPH
M.E. Vance, Ohio State U. Research Foundation, Columbus, Scientific report no. 3, AFCRL 62-1008, Sept. 1962, 185 p., incl. illus., tables, refs., AD 297 068.

AN OPTICAL CALORIMETER FOR LASER ENERGY MEASUREMENTS (Correspondence)
J.A. Calviello, Proc. IEEE, vol. 51, no. 4, April 1963, p. 611/612.

MODES IN A MASER INTERFEROMETER WITH CURVED AND TILTED MIRRORS
A.G. Fox, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 80/89.

Fabry-Perot interferometers have played an important role in the conception and realization of optical masers. . . . continued study . . . of certain simple forms of aberration. . . . useful in choosing proper mirror spacing for low loss operation of optical masers.

COMMENT ON "A METHOD FOR CALIBRATION OF LASER ENERGY OUTPUT" (Correspondence)
A.L. Glick, Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1360.

APPLICATION OF THE SENARMONT POLARISCOPE TO ANALYSIS OF OPTICAL MASER LIGHT
D. Hellerstein, Appl. Optics, vol. 2, Aug. 1963, p. 801/805, A63-21166.

SERVO-TECHNIQUES IN FABRY-PEROT INTERFEROMETRY
H. Kobler, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 9, Sept. 1963, p. 677/684.

. . . Fabry-Perot interferometer . . . Errors in position are sensed optically, using small sections of the surfaces. . . .

INTENSITY MEASUREMENTS FOR OPTICAL MASER APPLICATIONS
W.K. Kolbe, Electronics Research Lab., U. of Calif., Berkeley, 22 April 1963, 17 p., AD 411 782, N63-19405.

. . . of visible and near-visible light . . . A photoelectric method was used . . .

A SIMPLE METHOD FOR CALIBRATION OF RUBY LASER OUTPUT (Correspondence)
R.C.C. Leite, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 606/607.

THE DETERMINATION OF OPTICAL BANDWIDTH FROM PHOTOELECTRIC MIXING EXPERIMENTS WITH RUBY LASERS
M.S. Lipsett, et al., Appl. Optics, vol. 3, May 1964, p. 643, 12 refs., A64-17635.

. . . using light beams from two completely independent ruby lasers. . . . Almost steady beat notes are recorded for periods of order 10μ sec, and the observed beat spectrum is found to correspond to a spectral linewidth of order 100 to 200 kc.

COHERENCE TIME MEASUREMENTS OF LIGHT FROM RUBY OPTICAL MASERS
M.S. Lipsett, et al., Nature, vol. 199, Aug. 10, 1963, p. 553/555, 23 refs., A63-22069.

. . . The beat notes in the photoelectric fluctuations resulting from the super-position of light beams from two independent ruby lasers on a photocell are detected. Analysis of oscilloscope traces of the superposed beams indicate a coherence time of the order of 0.5μ sec.

GLASS LASER RESEARCH
T. C. MacAvoy, et al., Corning Glass Works, N.Y., Annual technical rept., May 1962-June 1963, 28 June 1963, 128 p., AD 429 010, AD 419 196.

A study of the spectral properties of Nd-doped glasses was undertaken with the objects of (1) determining how the properties of glass influence the performance of an Nd-doped glass laser, and (2) developing the best possible glasses for high power applications. . . .

PRECISE WAVELENGTH MEASUREMENT OF INFRARED OPTICAL MASER LINES
P.G. McMullin, Appl. Optics, vol. 3, May 1964, p. 641/642, 7 refs., A64-17634.

. . . Several maser lines are identified through wavelength measurements, using a precision spectrometer. . . . Eight Kr lines are seen, clearing up one ambiguity, and two Xe lines are observed due to very low concentrations of Xe present as an impurity in other gases.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia U., New York, N.Y., Radiation Lab., Second Quarterly Progress Report, March 16 through June 15, June 15, 1963, 71 p., refs.,N63-20033.

. . . A new, lov temperature, Q-switched ruby laser has been constructed as the excitation source for a photon echo experiment. . . . A new laser spectrometer has been constructed and tested. . . .

NOISE MEASUREMENT IN AN He-Ne LASER AMPLIFIER
R.A. Paananen, et al., Applied Physics Letters, vol. 4, April 15, 1964, p. 149/151, 7 refs., A64-17541.

. . . theoretical noise output was obtained by integrating the product of this distribution times the gain factor of the amplifier over the complete frequency range. . . .

INTERFEROMETRIC INVESTIGATION OF MODES IN OPTICAL GAS MASERS
T.G. Polanyi, et al., J. Opt. Soc. Amer., vol. 54, April 1964, p. 449/454, 17 refs., A64-16564.

. . . measurements with a Fabry-Perot interferometer . . . The technique makes feasible the analysis of the output of IR optical masers in a range of frequencies where only slow detectors are available.

INVESTIGATION OF LASER BEAM CROSS-SECTION WITH RESPECT TO INTENSITY AND TIME
W. Rambauske, et al., Dayton U. Research Inst., Ohio, Quarterly progress rept. no. 3, 1 Jan.-31 March 1963, 31 March 1963, 41 p., AD 405 482.

It was discovered that no two points in the laser beam cross-section displayed the same intensity versus time variation. These results were obtained by utilizing two identical detection systems positioned at various points in the beam's cross-section.

TIME-RESOLVED SPECTROSCOPY OF RUBY LASER EMISSIONS
S. L. Ridgway, et al., J. Opt. Soc. Amer., vol. 53, June 1963, p. 700/703, A63-20182.

Application of an image-converter camera to the study of transient phenomena in the emission from ruby lasers. . . .

PHOTOELECTRIC ENERGY METER FOR MEASURING LASER OUTPUT (Correspondence)
E. Schiel, Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 365/366.

STUDY OF LASER OUTPUT PARAMETERS AND MEASUREMENT TECHNIQUES
E.R. Schineller, et al., Wheeler Labs., Inc., Great Neck, N.Y., Final rept., 20 May-20 Nov. 1963, Rept. no. 1182, RADC TDR 63 564, Feb. 1964, 163 p., AD 433 174.

. . . parameters associated with system applications involving both energy and information transfer. . . . parameters of the solid state, gaseous, and diode lasers were computed theoretically and finally measurement principles were reviewed. . . . definitions of a wide variety of parameters needed to describe the many different properties of laser radiation in space and time. . . .

DETERMINATION OF THE ENERGY OF A PULSED LASER BEAM BY TRANSFER OF THE PHOTON MOMENTUM TO A BALLISTIC TORSIONAL PENDULUM
M. Stimler, Naval Ordnance Lab., White Oak, Md., NOL TR63 82, Oct. 1963, 70 p., AD 420 469.

An instrument has been designed and constructed which is capable of measuring high energies of pulsed laser beams, without seriously interfering with their simultaneous use in an experiment. . . .

SOME EXPERIMENTAL MEASUREMENTS OF THE CHARACTERISTICS OF Q-SWITCHED LASERS
R. E. Whitacre, Antenna Lab., Ohio State U. Research Foundation, Columbus, Rept. no. 1579 5, 15 Nov. 1963, 46 p., AD 429 006.

Measurements of the variation in peak power output from a Keer cell Q-switched ruby laser and a rotating roof prism Q-switched ruby laser as a function of the parameters of the laser systems . . .

EXPERIMENTAL INVESTIGATION OF FABRY-PEROT INTERFEROMETERS (Correspondence)
R.W. Zimmerer, Proc. IEEE, vol. 51, no. 3, March 1963, p. 475/476.

Related Publications:

FAR-FIELD RADIATION PATTERN
C.J. Lasher, et al., International Business Machines Corp., Yorktown Heights, N.Y., Thomas J. Watson Research Center, In its Injection Laser Study, 1963 p. 29/32, refs., N64-17872.

Numerical calculations are being conducted to determine the angular distribution of the far-field radiation pattern of an idealized three-region model of a laser. . . . From this model it will be possible to have a fairly complete description of the wave inside the crystal, its gain, and the far-field pattern . . .

INVESTIGATION OF THE DIRECTIVITY OF A LASER (Translation)
M. P. Vaniukov, et al., Soviet Physics — JETP, vol. 17, Nov. 1963, p. 1004/1006, A64-10037.

. . . directivity of the stimulated radiation from lasers with square, rectangular, and octagonal cross sections. . . .

Section 3B.35

3B.350: Optical Modulators

Included: Modulation of xenon arc lamps; Frequency modulation of light beams; Polarization modulation of light; Absorption modulation; Magneto-optic modulation of light beams; Diamagnetic Faraday effect modulator; SSB-suppressed carrier modulation of coherent light beams; Kerr cells in light modulators; Piezoelectric optical maser modulator; Pockel's effect light modulator; Cuprous chloride light modulators; Traveling wave light modulators; Microwave modulation of light; Modulation by light bunching; Traveling wave phase modulator.

Not Included: Modulation methods for communications (1).

Cross References: Millimeter wave modulators (3B.250); Traveling wave phototube (3B.370).

Principal Publications:

DEVELOPMENT OF OPTICAL FREQUENCY MODULATION TECHNIQUES
J.B. Goodell, Westinghouse Electric Corp., Baltimore, Md., Rept. no. C-15302Y-153, Dec. 1961, 142 p., 11 refs., AD 271 928, AD 268 951.

. . . theoretical investigation of a frequency modulation optical communication system. This system employs the Zeeman effect to split a spectral line into several components so that part of its initial radiancy will be passed by an absorption cell at the receiver. A transmission function was obtained for the Hg2537 Angstroms spectral line which splits into 3 Zeeman Components. A simple rectangular absorption curve and rectangular emission line are also discussed.

SOLID STATE MODULATORS FOR INFRARED COMMUNICATIONS
D.W. Kruse, et al., Electronics, no. 34, March 1961, p. 177/181.

SOLID STATE BEAM CONTROLLED LIGHT MODULATOR
E. Lindberg, et al., Motorola, Inc., Chicago, Ill., RADC TDR 63 161, 21 June 1961, 43 p., AD 413 403.

. . . to prove the feasibility of an electron beam controlled solid-state light modulator . . . experiments exhibiting the Pockel's electro-optical effect and the reflex principle. Different types of tubes were used . . . A major problem encountered was the high vapor pressure of the crystal material. Thus, it is recommended that the crystal be mounted on the outside of the tube or inside the tube within a sealed volume, or inside the tube with a suitable means of gettering or continuous pumping.

PULSE, MODULATION AND SCANNING TECHNIQUES (UV TO IR SPECTRAL REGION
W.R. Wilson, Optical Communications Lab., Northwestern U., Evanston, Ill., 1 June 1960-15 Aug. 1961, Final rept., 15 Aug. 1961, 13 p., AD 266 156.

. . . a survey of the techniques employed for modulating light sources was made.

ON THE MODULATION OF OPTICAL MASSERS (Correspondence)
F.S. Barnes, Proc. IRE, vol. 50, no. 7, July 1962, p. 1686/1687.

DESIGN OF A MICROWAVE-FREQUENCY LIGHT MODULATOR
R.H. Blumenthal, Proc. IRE, vol. 50, no. 4, April 1962, p. 452/456.

. . . Intensity modulates a light beam at modulating frequencies in the microwave region . . .

A RESEARCH PROGRAM ON THE UTILIZATION OF COHERENT LIGHT
D.J. Blattner, et al., David Sarnoff Research Center, Princeton, N.J., Interim rept. no. 6, 1 Oct.-31 Dec. 1962, 20 Jan. 1963, 28 p., incl. illus., 11 refs., AD 296 145.

. . . a cuprous-chloride electro-optic modulator . . . used . . . in a demonstration of an optical maser communications system carrying an audio channel . . .

MODULATION OF XENON ARC LAMPS
J.K. Buckley, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 154/161.

SINGLE-SIDEBAND SUPPRESSED-CARRIER MODULATION OF COHERENT LIGHT BEAMS (Correspondence)
C.F. Buhrer, et al., Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1827/1828.

. . . with a coherent carrier obtained from a helium-neon gas laser . . .

SINGLE-SIDEBAND MODULATION AND RECEPTION OF LIGHT AT VHF (Correspondence)
C.F. Buhrer, et al., Proc. IRE, vol. 50, no. 12, Dec. 1962, p. 2492.

. . . an extension of the phasing method of SSB modulation to optical frequencies. . . . we present a VHF version of this light modulator and then describe an optical analog of the phasing method of SSB reception. . . .

DEVELOPMENT OF A GERMANIUM SEMICONDUCTOR MODULATOR
M. L. Chatkoff, Minneapolis-Honeywell Regulator Co., Los Angeles, Calif., Final rept., Rept. no. R-ED-11184, ASD TDR 62-370, Sept. 1962, 1 v., incl. illus., table, 4 refs., AD 289 816.

. . . infrared modulator . . . Absorption ranged from 40% at a wavelength of 2 microns to 95% at 12 microns. Transmissions in the order of 90% were obtained with the proper antireflecting coating.

HIGH FREQUENCY MODULATION OF LIGHT
B. Curnutte, Jr., Kansas State U., Manhattan, Final rept., July 1962, 23 p., AD 297 872.

ULTRASONIC FEEDBACK MODULATION OF AN OPTICAL MASER OSCILLATOR (Correspondence)
A.J. DeMaria, et al., Proc. IRE, vol. 50, June 1962, p. 1522.

MODULATION AND DEMODULATION OF COHERENT AND INCOHERENT LIGHT AT A MICROWAVE FREQUENCY
S.E. Harris, et al., Stanford Electronics Labs., Stanford U., Calif., Technical rept. no. 176-3, Rept. no. SEL-62-119, Sept. 1962, 7 p., incl. illus., 4 refs., AD 296 920.

. . . describes the modulation and demodulation of both the incoherent light from a mercury-arc lamp and the coherent light from a ruby laser, at a modulation frequency of 2700 Mc. The light was demodulated by a microwave phototube. These are believed to be the first experiments with microwave-modulated light in which the light has been directly demodulated and the microwave modulating signal has been directly recovered.

PIEZOELECTRIC OPTICAL-MASER MODULATOR
L.F. Johnson, et al., J. Appl. Phys., vol. 33, no. 12, Dec. 1962, p. 3440/3443.

. . . employing a transparent piezoelectric medium . . . based on multiple interference in transmission or reflection, the intensity in the interference pattern being modulated by a change in thickness of the piezoelectric plate. . . . permits bandwidths ~200 Mc/s. A slight modification allows the device to operate purely as a phase modulator. . . .

MICROWAVE MODULATION OF LIGHT
W.M. Macek, et al., IRE Internat. Conv. Rec., Pt. 3, no. 10, March 1962, p. 158/176.

. . . Numerous techniques are . . . available to permit intensity modulation of light at low frequencies. . . . the need to extend the modulation frequency into the microwave region is apparent in practical Doppler radar and wideband communication applications.

Although there are many physical effects which might seemingly be utilized to achieve high-frequency modulation, only a few can be practically applied to this problem . . . applicability of the Pockels effect. . . . electro-optical microwave light beam modulator.

. . . practical device operating in the region from 200-2000 Mc. . . . resulted from an extensive research and development program conducted during the past two years.

A LIGHT SOURCE MODULATED AT MICROWAVE FREQUENCIES (Correspondence)
J.I. Pankove, et al., Proc. IRE, vol. 50, no. 9, Sept. 1962, p. 1976/1977.

. . . Since minority-carrier lifetimes of the order of 10^{-10} sec are readily obtained in GaAs, one may expect that the recombination radiation can be modulated at Gc rates. This communication reports a verification that efficient generation of light modulated at microwave frequencies is possible. . . .

INVESTIGATION OF OPTICAL SPECTRAL REGIONS FOR SPACE COMMUNICATIONS
R.A. Rollin, Jr., Institute of Science and Tech., U. of Michigan, Ann Arbor, Interim rept. no. 2, 1 May-31 July 1962, Rept. no. 4968-2-P, AD 287 640.

. . . literature search on transmitter and receiver components . . . literature on optical-transmitter modulators and modulation techniques and on optical-system lenses and reflector-aperture characteristics. . . .

MICROWAVE MODULATION AND DEMODULATION OF LIGHT
A. E. Siegman, et al. , Stanford Electronics Labs., Stanford, Calif., Technical rept. no. 176-2, Rept. no. SEL-62-079, July 1962, 16 p., incl. illus., 21 refs., AD 291 428.

Methods for modulating and demodulating coherent light signals at microwave modulation frequencies are presented. . . . if a technique does not offer the possibility of modulation bandwidths in excess of 1000 Mc, it is not considered. Work from a variety of laboratories is summarized. Emphasis is given, however, to the potentialities of the optical superheterodyne receiver incorporating an emerging optical device, the microwave phototube. Experiments verifying the important features of this type of receiver are described.

MICROWAVE MODULATION AND DEMODULATION OF IGHT
A. E. Siegman, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 384/391.

MICROWAVE MODULATION OF LIGHT WITH ADP
M. C. Watkins, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 104/106.

Fundamentally, the modulator consists of a basal section of a uniaxial crystal of the type XH_2PO_4 within a strong electric field. The crystal slab is orientated so that the optic axis is parallel to this field. Under the influence of RF energy the crystal becomes biaxial and linearly polarized light propagating parallel to the electric field is rendered elliptically polarized. The emerging elliptically polarized light is incident upon a linear polarizer whose orientation is orthogonal to the original linearly polarized light. . . .

PROPOSAL FOR MODULATING THE OUTPUT OF AN OPTICAL MASER (Correspondence)
Proc. IRE, vol. 50, March 1962, p. 323.

MODULATORS AND DEMODULATORS FOR LASER SYSTEMS
D. J. Blattner, et al., Radio Corp. of America, Princeton, N. J., In RCA, Camden, N. J., Lasers, 1963, p. 12/15, refs., N64-12563.

Wideband laser modulators that utilize crystals exhibiting linear electro-optic effects are under investigation, and work is being conducted on special microwave phototubes capable of demodulating light that has been modulated at gigacycle rates . . .

THEORY OF LIGHT MODULATION BY THE DIAMAGNETIC FARADAY EFFECT
N. Bloembergen, et al., J. Opt. Soc. Amer., vol. 54, April 1964, p. 551/552, 10 refs., A64-16573.

ELECTRO-OPTIC LIGHT MODULATION WITH CUBIC CRYSTALS
C. F. Buhrer, et al., Appl. Optics, vol. 2, Aug. 1963, p. 839/846, A63-21173.

Analysis of the linear electro-optic effect in crystals of classes containing a threefold rotation axis. . . . analysis shows it is possible to modulate a light beam simultaneously with two independent signals in the form of mutually perpendicular fields both transverse to the light beam.

OPTICAL MODULATION BY LIGHT BUNCHING (Correspondence)
C. F. Buhrer, Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1151.

The Pockels effect in crystals such as potassium dihydrogen phosphate (KDP) can be used to amplitude modulate a light beam at a microwave rate. . . .

MODULATION OF RUBY LASER OUTPUT BY ABSORPTION (Correspondence)
D. Chen, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 227/228.

SINGLE SIDEBAND MODULATION OF COHERENT LIGHT BY BRAGG REFLECTION FROM ACOUSTICAL WAVES (Correspondence)
H. Z. Cummins, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1246.

It has been verified experimentally that Bragg reflection of light by traveling ultrasonic waves in water produces a shift in the frequency of the light which is identical to the ultrasonic driving frequency. This effect provides a simple method for shifting light frequencies in optical heterodyning or homodyning experiments and spatially separates the shifted component from the unshifted forward beam. We have employed this method to study further the process of optical phase modulation described by Rabinowitz, Jacobs, Targ and Gould. . . .

INVESTIGATION OF LASER MODULATION BY MODIFYING THE INTERNAL REFLECTION BARRIER
H. A. Daw, J. Opt. Soc. Amer., vol. 53, Aug. 1963, p. 915/917.

. . . A quantity d logT/d log n which relates the fractional change of transmittance to the fractional change of refractive index is defined and shown to be large for large barrier spacing. It is suggested that this strong dependence of transmittance on the value of n may be used in studying and controlling laser beams.

ELECTRO-OPTIC INTERFERENCE FILTER LIGHT MODULATOR (Correspondence)
X. De Angelis, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1258.

. . . utilizing the Pockels effect . . . An electro-optic interference filter modulator has been developed which operates at greatly reduced voltages and power, having a compact structure and the potential of high modulation rates. The modulator is a Fabry-Perot interference filter which is capable of being tuned by utilizing an electro-optic material as the interference filter dielectric. . . .

BROADBAND ELECTRO-OPTIC TRAVELING-WAVE LIGHT MODULATORS
M. DiDomenico, Jr., et al., Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2621/2678.

. . . using single crystals of currently available materials. The structure analyzed is that first proposed by Rigrod and Kaminow in which a light beam is reflected back and forth across a microwave transmission line with the angle between optical and microwave phase velocity vectors chosen so that the component of the optical phase velocity vector in the direction of microwave propagation is equal to the microwave phase velocity . . .

THE MODULATION OF LIGHT IN A DOUBLE RESONANCE EXPERIMENT
J. N. Dodd, et al., Royal Society (London), Proceedings, Series A, vol. 273, 23 April 1963, p. 41/68, 21 refs., A63-17212.

SOLID-STATE TECHNIQUES FOR MODULATION AND DEMODULATION OF OPTICAL WAVES
D. D. Eden, Texas Instruments Inc., Dallas, Quarterly progress rept. no. 4, 1 Feb.-30 April 1963, Rept. no. U4 74000 4, 30 April 1963, 30 p., AD 417 225, AD 437 647, and AD 401 068.

An optical am-fm converter using rutile has been successfully demonstrated at high UHF modulation frequencies. A traveling wave quartz modulator of light has been successfully demonstrated at high UHF modulation frequencies. The use of "optical mixing" in a helium-neon gas phase laser as a modulation detection tool has proven quite successful. For example, Pockel's modulation at 910 mc has been monitored with a detector capable of responding to only a few hundred megacycles, by this method. . . . Modulated light from a gallium arsenide light emitting diode transmitted along a one meter air path has been detected by a silicon photodiode at 650 mc.

SOLID STATE TECHNIQUES FOR MODULATION AND DEMODULATION OF OPTICAL WAVES
D. D. Eden, et al., Texas Instruments, Inc., Dallas, Quarterly progress rept. no. 1, 1 July - 30 Sept. 1963, 29 p., Rept. no. U1 802400 1, AD 427 740.

. . . new types of modulators were developed and tested . . . A hexamethylene-tetramine light modulator . . . A 45-degree Z-cut KDP crystal light modulator operating with a field transverse to the light path . . . A traveling wave quartz modulator . . .

PROPOSAL FOR MICROWAVE MODULATION OF LIGHT EMPLOYING THE SHIFT OF OPTICAL ABSORPTION EDGE WITH APPLIED ELECTRIC FIELD (Correspondence)
R. C. Eden, et al., Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1776/1777.

. . . This method of light modulation is especially interesting in that it should be useable with extremely high modulating frequencies. The effect of an applied electric field on the optical absorption characteristics of a crystal has been treated theoretically by Franz and Keldysh. . . .

NEW METHOD FOR THE DETERMINATION OF ANISOTROPY RELAXATION TIME AND MODULATION OF LIGHT IN A KERR CELL
I. L. Fabelinskii, Soviet Physics —JETP, vol. 18, Feb. 1964, p. 564/565, 9 refs., A64-16107. (Translation)

ELECTROACOUSTIC DEFLECTION OF A COHERENT LIGHT BEAM (Correspondence)
A. J. Giarola, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1150/1151.

THEORETICAL AND EXPERIMENTAL INVESTIGATION ON MODULATION INDUCING RETRODIRECTIVE OPTICAL SYSTEMS
B. W. Harned, et al., Philco Corp., Blue Bell, Pa., Scientific Lab., Monthly Contract Progress Report No. 4, 21 Aug. - 21 Sept. 1963, 26 Sept. 1963, 8 p., refs., N64-11109.

. . . further exploration of optical pumping. Previous reports that microwave and low radio-frequency signals can disturb optical alignment were confirmed during this period in experimental tests which indicated other means for cross modulation . . .

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF MODULATION INDUCING RETRODIRECTIVE OPTICAL SYSTEMS
B. W. Harned, et al., Philco Corp., Blue Bell, Pa., Monthly Contract Progress Report No. 5, 21 Sept. - 21 Oct. 1963, 28 Oct. 1963, 7 p., refs., N64-12395.

. . . The cross modulation of radiation beams has been demonstrated. The optical pumping model previously reported was incorporated in the newly constructed demonstration model . . .

INVESTIGATION OF GAS LASERS AND NON-LINEAR OTPICAL EFFECTS
T.S. Hartwick, et al., Aerospace Corp., Los Angeles, Calif., Semiannual tech. note, 1 Jan.-30 June 1963, Rept. no. TDR169 3250 21 TN 2, 21 Dec. 1963, 45 p., AD 430 129.

. . . frequency modulation of a gas laser by a time-varying axial magnetic field. . . . Analysis and experimental results show that the "gain-switching" technique will be very useful for the repeated, reliable production of short, high-power laser pulses needed in the study of nonlinear optical effects and in optical radar.

HARMONIC STRUCTURE OF MODULATED LIGHT BEAMS
J.E. Hopson, IEEE Trans. Commun. Syst., vol. CS-11, no. 4, Dec. 1963, p. 464/469, 15 refs.

. . . modulation of light by means of electro-optic modulators and the detection and analysis of the modulation by means of photocell detectors. . . . anisotropic materials used to create the modulation effects. . . . harmonic structure for a variety of electro-optic modulators. Comparisons . . . between the frequency and power responses of the various modulators.

SOLID-STATE MODULATION AND DIRECT DEMODULATION OF GAS LASER LIGHT AT A MICROWAVE FREQUENCY (Correspondence)
K.M. Johnson, Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1368/1369.

. . . with a cavity-type KDP modulator and a Si photovoltaic diode demodulator. . . .

PROPAGATION CHARACTERISTICS OF PARTIALLY LOADED TWO-CONDUCTOR TRANSMISSION LINE FOR BROADBAND LIGHT MODULATORS
I.P. Kaminow, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 132/136.

STRAIN EFFECTS IN ELECTRO-OPTIC LIGHT MODULATORS
I.P. Kaminow, Appl. Optics, vol. 3, April 1964, p. 511/515, 9 refs., A64-16298.

LICHT-MODULATOREN FUR BREITE FREQUENZBANDER (Light Modulators for Wide Frequency Bands) (In German)
W. Klockhaus, Nachrichtentech. Z., vol. 16, Nov. 1963, p. 561/568.

Survey of the principal current methods for wide-band modulation of light waves. Particular attention is given to the control of emission processes in semiconductor lasers. . . .

A MONOCHROMATOR WAVELENGTH MODULATION
A.F. Kuckes, Princeton U. Plasma Physics Lab., N.J., Jan. 1963, 9 p., N63-16468.

. . . Using this modulation technique and a phase detection scheme, a method is described whereby the Doppler shift is easily obtained.

MODULATION OF INFRARED BY FREE CARRIER ABSORPTION
R.B. McQuistan, et al., J. Appl. Phys., vol. 35, April 1964, p. 1243/1248, 11 refs., A64-16965.

Application of the phenomenon of free carrier absorption in germanium to the modulation of IR radiation . . . Modulators have been fabricated having modulation bandwidths in the range 10^5 to 10^6 cps. Experimentally determined modulator characteristics are compared with theoretical predictions.

METHODS OF MODULATING INFRARED RADIATION
T.S. Moss, Royal Aircraft Establishment, Farnborough (Gt. Brit.), In AGARD, Paris Light and Heat Sensing, 1963, p. 207/220, refs., N64-15468.

. . . emphasis on systems that can operate at very high frequencies, the aim being to modulate up to $\sim 10^{10}$ c/s . . . Devices using pure field effects have negligible delay times and are potentially capable of operating at the highest frequencies desired. Frequency response and degree of modulation are estimated in terms of fundamental limitations and of practical materials.

POLARIZATION MODULATION AND DEMODULATION OF LIGHT
W. Niblack, et al., Appl. Optics, vol. 3, Feb. 1964, p. 277/279, A64-14262.

Description of an optical communication system employing polarization modulation-demodulation. The system offers significant improvements in usable transmitted power or extended range, lessened susceptibility to interference from linearly polarized background light, and ease of transmitter/receiver alignment over the performance of a comparable intensity-modulated optical communication system.

GIGACYCLE BANDWIDTH COHERENT LIGHT TRAVELING-WAVE PHASE MODULATOR
C.J. Peters, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 147/153.

A continuous duty coherent light phase modulator has been constructed which exhibits a bandwidth in the kilomegacycles. A modulation index of unity has been obtained with a modulation peak power of about 12 watts. This power level is independent of the bandwidth of the modulation. This is contrasted with known microwave amplitude light modulators which require peak modulation power in the kilowatts and exhibit bandwidths of the order of 30 Mc. . . . obtained by applying the modulation voltage to the electro-optical material by means of a traveling-wave structure of the transmission line type. . . . The magnitude of the angular modulation was determined by illuminating the modulator with a ruby laser and examining the individual spectral components of the output with an S-band traveling-wave microwave phototube receiver. Similar to the behavior of conventional FM systems, a minimum in the carrier at a modulation index of 3.75 was observed as well as the appearance of the appropriate sidebands. . . .

PULSE MODULATION OF GALLIUM ARSENIDE INJECTION LUMINESCENT DIODE LASER (Correspondence)
J. P. Quine, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1141/1142.

. . . Modulation at 200 Mc has been demonstrated using a gallium arsenide injection luminescent junction diode radiating incoherent light. The present correspondence reports on pulse modulation of gallium arsenide laser diodes operated at current levels above threshold for stimulated emission. The principal factor which limits modulation performance arises from heat generated electrically in the diode. . . .

COMMUNICATION USING FREQUENCY-MODULATED LIGHT
J. V. Ramsay, et al., Proc. Instn. Radio Engrs. Australia, vol. 24, no. 9, Sept. 1963, p. 673/677.

. . . It is of interest . . . to investigate the relative merits of frequency and amplitude modulation for communication with the very high "carrier" frequencies (of the order of 10^{14} c/s) of light. . . .

VOICE MODULATION OF AN ELECTRO-ACOUSTICALLY DEFLECTED LIGHT BEAM (Correspondence)
A. Reich, et al., Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1661/1662.

WIDE-BAND MICROWAVE LIGHT MODULATION
W.W. Rigrod, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 137/140.

. . . by traveling-wave interaction in electro-optic or magneto-optic materials . . . Structures are described. . . in which the microwave field is largely concentrated in the electro-optic medium, resulting in very little dispersion and economical use of microwave power. The use of the linear electro-optic effect in potassium dihydrogen phosphate (KDP) in such applications is considered.

DIRECT MODULATION OF A He-Ne GAS LASER (Correspondence)
E. J. Schiel, et al., Proc. IEEE, vol. 51, no. 6, June 1963, p. 940/941.

Modulation of a laser beam can be achieved either by passing the light through a modulator after the light has left the laser (indirect modulation) or by changing one of the operational parameters of a laser system, e.g., modulating the pump (direct modulation). . . . In our experimental arrangement a He-Ne gas laser with a confocal resonator configuration and emitting at 11,530 A was pumped by a Johnson Viking Valiant transmitter. . . . By modulating the pump between threshold and maximum, 100 per cent amplitude modulation can be achieved.

MAGNETO-OPTIC MODULATION OF A LIGHT BEAM IN SODIUM VAPOR
B. M. Schmidt, et al., J. Opt. Soc. Amer., vol. 54, April 1964, p. 454/459, 10 refs., A64-16565.

FIELD-EFFECT LIGHT MODULATION IN GERMANIUM
B.O. Seraphin, et al., Naval Ordnance Test Station, China Lake, Calif., NAVWEPS 8408, NOTS TP3336, 10 Sept. 1963, 6 p., AD 423 300.

Infrared light that is sent through a germanium prismatoid so that it is reflected several times internally, becomes modulated in intensity if the space-charge layers along the reflecting surfaces are changed by means of the field effect. . . .

APPLIED RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION
S. E. Sobottka, Watkins-Johnson Co., Palo Alto, Calif., Interim engineering rept. no. 3, 1 Jan.-31 March 1963, W J63 610R12, 31 March 1963, 14 p., AD 404 632.

. . . constructing a convergent gun traveling-wave phototube. The light modulator design and construction has been completed and tested. With 1.3 watts of input rf power at 3420 mc/sec, the modulation index is 0.1. This modulator, together with a superpressure Hg-arc light source, will be used to determine the rf characteristic of the phototubes.

CUPROUS CHLORIDE LIGHT MODULATORS
F. Sterzer, et al., J. Opt. Soc. Amer., vol. 54, Jan. 1964, p. 62/68, 13 refs., A64-13038.

. . . The important advantages of the cubic electro-optic material CuCl over competing materials are demonstrated in light modulator applications. CuCl light modulators requiring only modest input power have been operated continously with bandwidths of tens of megacycles at microwave frequencies. Both visible and infrared radiation have been modulated, the modulators exhibited large angular aperture. Design principles are set forth for microwave modulators of both the resonant and traveling-wave type.

A REVIEW OF OPTICAL-ULTRASONIC INTERACTION WITH ILLUSTRATIVE APPLICATIONS TO COHERENT LIGHT PHENOMENA
V. Suprynowicz, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 564/568.

. . . use of the wide bandwidths available in the optical region has tended to overshadow the considerable utility of narrow bandwidth modulation schemes . . . systems utilizing optical-ultrasonic interaction have been demonstrated as holding considerable promise as identification "markers" for light beams, voice modulators of light, a means of deflecting light, etc. These functions are performed with extremely simple apparatus which as a consequence are quite inexpensive and highly reliable.
. . . history and theory of optical-ultrasonic interaction as applied to incoherent sources . . .

ELECTRO-OPTICAL MODULATORS EMPLOYING "INTERMITTENT INTERACTION" (Correspondence)
R. M. White, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 214.

. . . permits application of the Pockels effect and traveling-wave interaction to the wide-band modulation of a light beam. . . .

A PROPOSED METHOD FOR IMPROVING THE PASSBAND CHARACTERISTICS OF THE PERIODIC INTERFEROMETRIC MODULATOR
R.A. Williams, Ohio State U., Research Foundation, Antenna Lab., Columbus, Rept. 1093-15, 1 June 1963, 17 p., 3 refs., N63-18861.

. . .the response curve of an interferometric modulator may be improved by using miltiple-correlation techniques . . .

SOME OPTICAL MODULATION AND DEMODULATION TECHNIQUES
M.R. Wohlers, Grumman Aircraft Engineering Corp., Bethpage, N.Y., Research Dept., Aug. 1963, 25 p., refs., N64-14915.

This note discusses the use of electro-optic crystals for modulation, describes some techniques which have been proposed, and proposes or reevaluates some additional schemes . . . some devices discussed are time-varying systems, and the theory used is that of slow-time variation.

WIDE BAND COHERENT LIGHT MODULATOR
Baird Atomic, Inc., Cambridge, Mass., Final rept., July 1962-June 1963, Rept. no. 4067F, ASD TDR 63 604, Sept. 1963, 132 p., AD 421 838.

A thorough analysis is made of the theoretical factors affecting Fabry-Perot interferometers containing electro-optical crystals as phase-shifting elements and used as wide band modulators of coherent light. Bandwidth, modulation percentage and distortion, optical transmission, the effect of optical imperfections and modulator amplifier characteristics are discussed. . . . investigated . . . at frequencies up to 30 megacycles with a continuous gas laser operating at 6328 angstroms. Results of final tests indicate a modulation sensitivity one third of that expected, but a flat pass band out to 30 megacycles. . . .

Related Publications:

QUANTUM ELECTRODYNAMIC PREDICTION OF THE ENVELOPE MODULATION OF MASER BEAMS (Correspondence)
R.M. Bevensee, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 215/216.

DESIGN AND DEVELOPMENT OF A PHOTOMIXING DEVICE
D.E. Caddes, Sylvania Electric Products, Inc., Mountain View, Calif., Microwave Device Div., Final Report, AFCRL-63-379, 9 Aug. 1963, 76 p., refs., AD 422961, N64-12676.

A traveling-wave phototube (TWP) has been developed which is capable of photomixing optical signals of differeing frequency content and detecting the resultant difference frequency signal (beat) over the 11 to 20 Gc band. This represents the broadest bandwidth presently available in a practical photodetector. An important spectroscopic application of this tube would be in the examination of laser outputs. In addition to its photomixing capability, this TWP is a sensitive detector of amplitude modulation of light over this same broad bandwidth.

SPURIOUS HARMONIC GENERATION IN OPTICAL HETERODYNING
H.Z. Cummins, et al., Appl. Optics, vol. 2, Aug. 1963, p. 823/825, A63-21170.

. . . the simultaneous photo-detection of two incoherent light beams chopped at different frequencies yields a direct measurement of the cross-modulation coefficient of a photocathode. This is a technique generally applicable to the measurement of small nonlinearities on photodetectors.

OPTICAL MIXING AND DETECTION IN SEMICONDUCTORS
T. A. Midford, et al., Standard Telecommunications Labs., Ltd., Enfield (England), Annual rept. no. 2, 1963, 1v., AD 434 145.

PHOTOBEATS BETWEEN MODES IN RUBY LASERS
M. Silver, et al., Appl. Optics, vol. 3, April 1964, p. 539/540, 8 refs., A64-16304.

Section 3B.36

3B.360: Optical Demodulators

Included: Photocell optical detectors; Optical maser detectors; Laser demodulation; Push-pull optical demodulators; Light modulation detection; Nondegenerate photoparametric amplifier; Photomultipliers as optical detectors; Photon source detectors; Dynamic crossed field electron multiplier (DCFEM); Microwave phototubes; Quantum detectors; Black radiation detectors; Optical discriminator.

Not Included: Photo-electron physics; Theory of photo-electric devices.

Cross References: Optical receiving techniques in general (3B.370); Lasers (Sect. 3B.34); Optical mixing in optical receivers (3B.370); Traveling wave phototubes (3B.370).

Principal Publications:

RESEARCH STUDIES OF QUANTUM DETECTORS AND MIXERS
D. Blattner, et al., Radio Corp. of America, Harrison, N. J., Quarterly progress rept. no. 1, 1 July-30 Sept. 1962, 39 p., incl. illus., AD 292 791.

. . . optimum design concepts for photoemissive devices that are capable of detecting microwave modulation of light and also of mixing two coherent optical sources with a resultant difference frequency at a microwave frequency. A ppm-focused helix microwave phototube using a transmission photocathode was built. Use of a transmission photocathode simplifies optical alignment of the tube, and the photosensitivity of the cathode (s-20 photosurface) is orders of magnitude greater than that of the thermionic cathodes used in microwave phototubes reported by other investigators. A novel mixing mode of operation extends the operating range of the L-band tube to the range from 0 to 4 gc. Experimental results obtained with modulated incoherent sources and with beating of coherent laser sources are given.

FAST RESPONSE SOLID STATE PME DETECTOR FOR LASER SIGNALS
A. Boatright, et al., Army Research Office, Office of the Chief, Research & Development, Washington, D. C., 1962, 16 p., incl. illus., table, 17 refs., AD 286 656.

. . . photomagnetoelectric effect in germanium . . . for building sensitive, fast response photodetectors . . .

HIGH-GAIN DYNAMIC MICROWAVE PHOTOMULTIPLIER (Correspondence)
O. L. Gaddy, et al., Proc. IRE, vol. 50, Feb. 1962, p. 207/208.

. . . interest in optical communication techniques has created the need for photodetectors capable of responding to light with modulation components in the microwave region. . . . method which is called dynamic crossed-field electron multiplication (DCFEM).

MODULATION AND DEMODULATION OF COHERENT AND INCOHERENT LIGHT AT A MICROWAVE FREQUENCY
S. E. Harris, et al., Stanford Electronics Labs., Stanford U., Calif., Technical rept. no. 176-3; Rept. no. SEL-62-119, Sept. 1962, 7 p., incl. illus., 4 refs., AD 296 920.

. . . describes the modulation and demodulation of both the incoherent light from a mercury-arc lamp and the coherent light from a ruby laser, at a modulation frequency of 2700 Mc. The light was demodulated by a microwave phototube. These are believed to be the first experiments with microwave-modulated light in which the light has been directly demodulated and the microwave modulating signal has been directly recovered.

UNIQUE SENSORS STUDY PROGRAM
E. V. Hiatt, Texas Instruments Inc., Dallas, ASD TDR62 933, 17 Dec. 1962, 1 v., AD 405 763.

A program to determine whether a new type of detector could be developed to compete with present-day photon detectors in narrow radiation (approx. 1.0 angstrom) is described. The new detector utilizes the fact that measurable aftereffects occur in a pure gas or mercury vapor when metastable atoms of the gas absorb radiation.

HETERODYNE DETECTION IN OPTICAL COMMUNICATION
J. LaTourrette, et al. (editors), Technical Research Group, Syosset, N. Y., Technical note on Theoretical and Experimental Investigation of Broadband Coherent Optical Communication Techniques, Rept. no. TRG-168--TDR-1, RADC TDR 62-491, 30 Nov. 1962, 1 v., incl. illus., tables, refs., AD 296 362.

The properties of optical heterodyne detection are analyzed and measured using a LASER and a Twyman-Green interferometer. . . . preserves the signal-to-noise ratio in the detected difference frequency in the presence of incoherent noise. . . . demultiplexing of channels, demodulation of FM and AM, Doppler and displacement measurements, and stabilization of

LASERs is discussed. The elements of an optical communication link are discussed: LASERs, modulators, transmission path, and detectors.

STUDY OF ADVANCED SOLID STATE INFRARED DETECTION
D. W. Nyberg, et al., Boeing Co., Renton, Wash., Final Rept., Sept. 1960-Nov. 1962, Rept. no. D6-8896, ASD TDR 62-977, Nov. 1962, 229 p., AD 298 002.

INVESTIGATION OF OPTICAL SPECTRAL REGIONS FOR SPACE COMMUNICATIONS
R. A. Rollin, Jr., Institute of Science and Tech., U. of Michigan, Ann Arbor, Interim rept. no. 2, 1 May-31 July 1962, Rept. no. 4968-2-P, Nov. 1962, 118 p., incl. illus., tables, 65 refs., AD 287 640.

. . . photocathode-type and . . . photoconductive-type quantum detectors . . .

COHERENT LIGHT COMMUNICATION SYSTEMS UTILIZING A MICROWAVE BANDWIDTH PHOTON DETECTOR
M. Ross, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 1.5, Oct. 1962.

. . . the Dynamic Crossed Field Electron Multiplier (DCFEM) possesses the characteristics necessary for a coherent light communication system of microwave bandwidth. . . .

DETECTION AND AMPLIFICATION OF THE MICROWAVE SIGNAL IN LASER LIGHT BY A PARAMETRIC DIODE (Correspondence)
S. Saito, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2369/2370

. . . We have tested a semiconductor point-contact diode to check the possibility of detection of the microwave signal in laser light, and obtained an interesting result. . . .

MICROWAVE MODULATION AND DEMODULATION OF LIGHT
A. E. Siegman, et al., Stanford Electronics Labs., Stanford, Calif., Technical rept. no. 176-2; Rept. no. SEL-62-079, July 1962, 16 p., incl. illus., 21 refs., AD 291 428.

Methods for modulating and demodulating coherent light signals at microwave modulation frequencies are presented. . . . if a technique does not offer the possibility of modulation bandwidths in excess of 1000 Mc, it is not considered. Work from a variety of laboratories is summarized. Emphasis is given, however, to the potentialities of the optical superheterodyne receiver incorporating an emerging optical device, the microwave phototube. . . .

APPLIED RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION
S. E. Sobottka, et al., Watkins-Johnson Co., Palo Alto, Calif., Interim engineering rept. no. 2, 1 Oct.-30 Dec. 1962, Rept. no. W-J 63-610R8, 30 Dec. 1962, 21 p., incl. illus., 1 ref., AD 293 149, AD 286 217.

. . . study of convergent gun microwave phototubes. . . . photo-cathode fabrication . . .

RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION
E. O. Ammann, Electronic Defense Lab., Mountain View, Calif., Interim engineering rept. no. 7, 1 Dec. 1963-1 March 1964, Technical memo. no. M670, 20 March 1964, 32 p., AD 434 127, AD 420 403, AD 428 980.

. . . New results . . . in the following two areas: (1) synthesis techniques . . . for realizing an arbitrary optical transfer function . . . (2) technique . . . for modifying the birefrigent discriminator so that it can accommodate light of an arbitrary polarization.

MEASUREMENT OF THE MICROWAVE MODULATION FREQUENCY RESPONSE OF JUNCTION PHOTODIODES (Correspondence)
L. K. Anderson, Proc. IEEE, vol. 51, no. 5, May 1963, p. 846/847.

. . . to describe a simple technique for investigating the response of PIN-junction (1)-(4) photodiodes to light modulated at microwave frequencies. . . .

IMPROVED BLACK RADIATION DETECTOR
R. L. Bates, et al., Naval Ordnance Lab., Corona, Calif., NOLC rept. 594, Photodetector Series, 60, 15 Dec. 1963, 12 p., AD 426 778.

RESEARCH STUDIES OF QUANTUM DETECTORS AND MIXERS
D. Blattner, et al., Radio Corp. of America, Harrison, N. J., Quarterly progress rept. no. 4, 1 April-30 June 1963, 19 p., AD 416 229.

Calculation of the effective output resistance of the microwave phototube, including the effect of the cold loss in the helix, gave good agreement with measured values. A microwave phototube incorporating one stage of transmission secondary electron multiplication (TSEM) exhibited current gains up to 4.3 Microwave modulation carried on light pulses was detected in this tube . . .

OPTICAL MASER DETECTION BY MICROWAVE ABSORPTION IN SEMICONDUCTORS
F. A. Brand, et al., Army Electronics Research and Development Agency, Fort Monmouth, N. J., 1963, 5 p., AD 424 681.

The phenomena of microwave absorption in semiconductors has been used to detect optical maser radiation. In particular, germanium specimens doped with copper to reduce lifetime were mounted at the center of a waveguide. Radiation from a pulsed ruby optical maser, with its characteristic spiking, was allowed to impinge on the semiconductor through a hole in the narrow wall of the guide. . . .

OPTICAL MASER DETECTION BY MICROWAVE ABSORPTION IN SEMICONDUCTORS
F. A. Brand, et al., IEEE Internat. Conv. Rec., vol. 11, no. 3, March 1963, p. 162/166.

. . . The phenomena of microwave absorption in semiconductors has been used to detect optical maser radiation. In particular, germanium specimens doped with copper to reduce lifetime were mounted at the center of a waveguide. Radiation from a pulse ruby optical maser, with its characteristic spiking, was allowed to impinge on the semiconductor through a hole in the narrow wall of the guide. The excess carriers which are generated in the region of maximum r-f field cause a modulation of the microwave energy which is then detected by conventional means and displayed on an oscilloscope. . . .

OPTICAL MASER DETECTION BY MICROWAVE ABSORPTION IN SEMICONDUCTORS (Correspondence)
F. A. Brand, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 607/609.

RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION
D. E. Caddes, et al., Sylvania Electric Products Inc., Mountain View, Calif., Interim engineering report no. 3, 1 Dec. 1962-1 March 1963, 1 March 1963, 43 p., incl. illus., 43 refs., AD 400 673.

OPTICAL COMMUNICATIONS EMPLOYING INFRARED EMITTING DIODES AND FM TECHNIQUES (Correspondence)
E. J. Chatterton, Proc. IEEE, vol. 51, no. 4, April 1963, p. 612.

SPECTRALLY SELECTIVE PHOTODETECTORS FOR THE MIDDLE AND VACUUM ULTRAVIOLET
L. Dunkelman, et al., NASA, Goddard Space Flight Center, Greenbelt, Maryland, Washington, NASA, TN D-1759, May 1963, 13 p., 32 refs., Presented at the meeting of the Opt. Soc. of Am., Los Angeles, Oct. 1961, N63-16392.

. . . "solar blind" photodetectors . . . By combining solar-blind cathodes with windows of LiF, CaF_2, or fused silica, detectors with relatively flat quantum efficiencies can be produced, marked by high sensitivities in specific ultraviolet spectral regions and by very low sensitivities at all longer wavelengths.

SOLID-STATE TECHNIQUES FOR MODULATION AND DEMODULATION OF OPTICAL WAVES
D. D. Eden, Texas Instruments Inc., Dallas, Quarterly progress rept. no. 2, 1 Aug.-31 Oct. 1962, Rept. no. U2-74000-2, 17 Jan 1963, 29 p., AD 401 068.

A number of wide-band modulators (dc to 500 mc and higher) were constructed using KDP. Y-cut quartz is being designed into a TEM travelling wave structure. . . . optical FM-AM converter using rutile . . . Good audio reception was obtained at 1000 ft using gallium arsenide light-emitting diodes and silicon detectors in hand-held units. Modulated light from a gallium arsenide diode was detected (using an air path) by a germanium photodiode at about 100 mc. Modulated light from a gallium arsenide diode at 900 mc was detected by a silicon photovoltaic detector using for a light path a tapered glass rod bonded to both source and receiver.

A MICROWAVE FREQUENCY DYNAMIC CROSSED-FIELD PHOTOMULTIPLIER
O. L. Gaddy, et al., Proc. IEEE, vol 51, no. 1, Jan. 1963, p. 153/162.

PHOTON-INDUCED FREE-CARRIER MODULATION OF INFRARED LIGHT IN GERMANIUM
R. M. Grant, Institute of Science and Tech., U. of Michigan, Ann Arbor, Rept. no. 4563 55T, Jan. 1964, 16 p., AD 429 003.

BALANCED OPTICAL DISCRIMINATOR
I. P. Kaminow, Appl. Optics., vol. 3, April 1964, p. 507/510, 7 refs., A64-16297.

. . . for detection of angle modulation on a light beam. The device is similar in principle to bridge-type microwave discriminators and optical birefringent crystal discriminators. An angle-modulated system at optical frequencies, employing a balanced discriminator, has advantages over intensity-modulated systems, which are more commonly used at radio frequencies. . . .

SIMPLE, ECONOMICAL LASER DEMODULATION
H. G. McGlees, et al., Electronic Indust., vol. 22, May 1963, p. 107/109, A63-17609.

. . . demodulation of an optical modulated signal. . . . usefulness of the simple vacuum photocell in the lower Gc range is not as limited as was previously supposed. . . . experiment with a photo-TWT (Sylvania SY 4302) to analyze the output of a laser using a 2.5-in. ruby in an elliptical cavity . . . experiment with an ordinary, commercially available, miniature phototube – the 1P42. . . .

PROPERTIES OF PHOTODETECTORS
A. B. Naugle, et al., Naval Ordnance Lab., Corona, Calif., Report for Oct. 1962-Jan. 1963 on Photodetector Series, 56th rept., Rept. no. NOLC 578, 1 Feb. 1963, 37 p., AD 299 001.

X-BAND MICROWAVE PHOTOTUBE FOR DEMODULATION OF LASER BEAMS (Correspondence)
M. D. Petroff, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 614/615.

Among the proposed methods of detecting microwave modulation of laser beams the use of photocathodes has been suggested and investigated. . . . first results with an X-band microwave phototube utilizing an S-1 photocathode used together with a broad-band microwave interacting structure of simple but effective design. . . .

AN OPTIMUM DEMODULATOR FOR POISSON PROCESSES; PHOTON SOURCE DETECTORS
B. Reiffen, et al., Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1316/1320.

The optimum demodulator for time-varying Poisson processes is derived from consideration of the likelihood ratio. In the case of high background level radiation, it has been found that the optimum signal processing is cross-correlation. Under an average energy constraint and conditions of high background radiation, an optimum binary signaling method is "on-off" modulation. For both binary signaling and radar purposes, the "on" waveform should be a narrow pulse in order to maximize the "signal-to-noise" ratio.

A NONDEGENERATE PHOTOPARAMETRIC AMPLIFIER (Correspondence)
D. E. Sawyer, Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1238.

. . . a diffused junction photodetector operating with integral nondegenerate parametric amplification. The mechanisms which determine the signal-to-noise ratio of such devices are discussed. Photoparametric operation was previously predicted, and has been demonstrated using a point-contact photodiode as a degenerate parametric amplifier. . . . In the present measurements a 22.5 Mc amplitude modulated GaAs incoherent electroluminescent diode was used as a radiation signal. . . .

APPLIED RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION
S. E. Sobottka, Watkins-Johnson Co., Palo Alto, Calif., Interim Engineering Report No. 3, 1 Jan. through 31 March, 1963, 1963, 18 p., 2 refs., N63-16344, AD 404 632.

. . . constructing a convergent gun traveling-wave phototube. . . .

APPLIED RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION – ADDENDUM
S. E. Sobottka, Watkins-Johnson Co., Palo Alto, Calif., Interim Engineering Report No. 3, 1 Jan. through 31 March 1963, 1963, 13 p., 2 refs., N63-17062, AD 406 933.

DEMODULATION OF LOW-LEVEL BROAD-BAND OPTICAL SIGNALS WITH SEMICONDUCTORS
H. S. Sommers, Jr., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 140/146.

"PUSH-PULL" OPTICAL MODULATORS AND DEMODULATORS
F. Sterzer, Appl. Optics, vol. 2, Nov. 1963, p. 1197/1198, A64-10948.

Presentation of schemes for doubling the output of push-pull optical amplitude modulators, and of demodulators for polarization modulated beams.

NONLINEAR PHOTOCELL RESPONSE DUE TO LASER BEAM SPREAD
M. Stimler, et al., Appl. Optics, vol. 3, April 1964, p. 538/539, A64-16303.

METHOD FOR DETECTING MICROWAVE MODULATED LIGHT (Correspondence)
G. H. Thiess, Proc. IEEE, vol. 51, no. 6, June 1963, p. 950.

. . . experimental arrangement . . . to detect a 50-Mc IF from a 750-Mc modulation frequency using two axial modes separated by 800 Mc. An He-Ne visible gas laser was used and the detector was an RCA 7102 photomultiplier. Further experiments using as a detector a fast PIN diode developed by Duane Adams of Texas Instruments produced signals as large as those from the photomultiplier. . . .

COUNTER MODELS AND APPLICATIONS TO DETECTION PROBLEMS
H. Zweig, Applied Mathematics and Statistics Labs., Stanford U., Calif., Technical rept. no. 87, 12 April 1963, 73 p., 20 refs., AD 402 352.

The quantum efficiency is derived of a variety of detectors for which mathematical models already exist . . . A new class of counters, is introduced and evaluated.

Related Publications:

STUDY AND INVESTIGATION OF MILLIMETER AND SUB-MILLIMETER WAVE RECEIVER TECHNIQUES
Electrical Engineering Research Lab., U. of Illinois, Urbana, Quarterly rept. no. 2, 1 June-1 Sept. 1962, RADC TDR 62-250, 15 Oct. 1962, 20 p., incl. illus., table, 3 refs., AD 289 809.

The pyroelectric effect detector was tested experimentally. The possibility of using metal reflectors rather than dielectric lenses for the phase correctors was investigated.

DEVELOPMENT OF A FAST SOLID-STATE ULTRAVIOLET PHOTODETECTOR
D. E. Brown, et al., Michigan U. Inst. of Sciences and Tech., Ann Arbor, Wright-Patterson AFB, Ohio, Electronic Tech. Lab., Rept. 4611-13-F; ASD-TDR-62-978, March 1963, 39 p., 12 refs., N63-16404.

. . . Efforts were concentrated on photovoltaic devices using metal semiconductor barrier layers. . . .

MIDDLE ULTRAVIOLET PHOTOELECTRIC DETECTION TECHNIQUES
L. Dunkelman, et al., NASA, Goddard Space Flight Center, Greenbelt, Md., In its Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962, May 1963, p. 125/137, 15 refs., N63-17111.

RECEIVERS FOR LASER RADARS
R. L. Forward, Hughes Research Labs., Malibu, Calif., Interim engineering rept. no. 1, 15 Nov. 1962-14 Feb. 1963, 15 Feb. 1963, 22 p., AD 416 249.

GIGACYCLE BANDWIDTH COHERENT LIGHT TRAVELING-WAVE PHASE MODULATOR
C. J. Peters, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 147/153.

. . . examining the individual spectral components of the output with an S-band traveling-wave microwave phototube receiver. Similar to the behavior of conventional FM systems, a minimum in the carrier at a modulation index of 3.75 was observed as well as the appearance of the appropriate sidebands. . . .

COMMUNICATION USING FREQUENCY-MODULATED LIGHT
J. V. Ramsay, et al., Proc. Instn. Radio Engrs. Australia, vol. 24, no. 9, Sept. 1963, p. 673/677.

. . . The system consists essentially of a sender (a tunable interferometer), and a receiver (another tunable interferometer servo-controlled to follow the frequency transmittance of the sender). . . .

HIGH SPEED HETEROJUNCTION PHOTODIODES AND BEAM-OF-LIGHT TRANSISTORS (Correspondence)
R. H. Rediker, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 218/219.

INFRARED PHOTOCONDUCTORS
M. L. Schultz, Radio Corp. of America, RCA Labs., Princeton, N. J., David Sarnoff Research Center, Summary Report, Dec. 31, 1963, 62 p., 11 refs., 263 refs., N63-18011.

ELECTROLUMINESCENCE: AN ANNOTATED BIBLIOGRAPHY
P. R. Stromer, Lockheed Missile and Space Co., Sunnyvale, Calif., Special bibliography SB-63-3, Rept 6-90-63-6, June 1963, 123 p., 263 refs., N63-18011.

The recent literature of carrier injection (d.c.) and intrinsic (a.c.) electroluminescence has been reviewed. Electroluminescence is defined as the excition of a phosphor by an electric field whereby electrical energy is converted to visible radiation. Other forms of energy such as photons, cathode rays, X-rays, etc., give rise to photoluminescence, cathodoluminescence, and X-ray luminescence, respectively. References to these other forms of luminescence have been included only in those instances where they have been studied in combination with electroluminescence.

RECEIVERS FOR LASER RADARS
Hughes Research Labs., Malibu, Calif., Interim Engineering rept. no. 3, 15 May-14 Aug. 1963, 14 Aug. 1963, 27 p., AD 415 691.

Section 3B.37

3B.370: Optical Receivers

Included: Optical amplifiers; Optical mixing; Light receivers; Heterodyning light receivers; Traveling wave optical amplifiers; Laser amplifiers; Optical maser amplifiers; Optical heterodyning; Traveling wave phototube.

Not Included: Image intensifiers.

Cross References: Lasers (Sect. 3B.34); Light Communications systems (Div. 3B.4).

Principal Publications:

TRAVELING-WAVE OPTICAL MASER
J. E. Geusic, et al., Bell Telephone Labs., Inc., Murray Hill, N.J., Quarterly rept. no. 1, 15 July-15 Oct. 1961 on Optical Maser Research, 15 Oct. 1961, 13 p., AD 271 538.

. . . design, construction, and testing of a nonreciprocal Traveling-Wave Optical Maser Amplifier (TWOM) resulted in the successful operation of a pulsed TWOM test section with a net gain of 12.2 db. . . . proven that a high gain (30-60 db) optical amplifier is feasible. (The use of this amplifier is being considered.) . . .

THE PULSED RUBY MASER AS A LIGHT AMPLIFIER
P. P. Kisliuk, et al., Proc. IRE, vol. 49, Nov. 1961, p. 1635/1639.

RESEARCH STUDIES OF QUANTUM DETECTORS AND MIXERS
D. Blattner, et al., Radio Corp. of America, Harrison, N.J., Quarterly progress rept. no. 1, 1 July-30 Sept. 1962, 39 p., incl. illus., AD 292 791.

. . . optimum design concepts for photoemissive devices that are capable of detecting microwave modulation of light and also of mixing two coherent optical sources with a resultant difference frequency at a microwave frequency. A ppm-focused helix microwave phototube using a transmission photocathode was built. Use of a transmission photocathode simplifies optical alignment of the tube, and the photosensitivity of the cathode (s-20 photosurface) is orders of magnitude greater than that of the thermionic cathodes used in microwave phototubes reported by other investigators. A novel mixing mode of operation extends the operating range of the L-band tube to the range from 0 to 4 gc. Experimental results obtained with modulated incoherent sources and with beating of coherent laser sources are given.

HETERODYNE RECEIVERS FOR RF-MODULATED LIGHT BEAMS
D. J. Blattner, et al., RCA Rev., vol. 23, no. 3, Sept. 1962, p. 407/412.

. . . The frequency of amplitude or phase modulation on a light beam can be shifted to a new value by passing the beam through an electro-optic modulator. Expressions for conversion loss are derived for a modulator using a crystal exhibiting the linear electro-optic effect . . . A suggested application is heterodyning high-frequency light modulation to the response ranges of available light demodulators.

STUDY OF A MOLECULAR TUNABLE INFRARED AMPLIFIER
M. Geller, Electro-Optical Systems, Inc., Pasadena, Calif., Final rept., June 1961-April 1962, Rept. no. 1880, ASD TDR 62-803, Nov. 1962, 49 p. incl. illus., tables, 25 refs., AD 289 538.

A semiconductor, such as silicon, is discussed as a candidate for laser oscillation. . . . The pulse operation of silicon in a laser configuration, at liquid nitrogen temperatures, revealed sharp discontinuities in the emission curve after 40 microseconds beyond the onset of the pump light. It is suspected, but not as yet unequivocably established, that these radiation spikes were laser oscillations. . . .

A UNIDIRECTIONAL TRAVELING-WAVE OPTICAL MASER
J. E. Geusic, et al., Bell Syst. Tech. J., vol. 41, no. 4, July 1962, p. 1371/1397.

. . . Experimental data on the performance of pulsed ruby amplifying sections and high density PbO glass Faraday rotation isolators are given. Feasibility tests on a two-section device have been made and are in agreement with predictions. . . .

PARAMETRIC AMPLIFICATION AND OSCILLATION AT OPTICAL FREQUENCIES
R. H. Kingston, Proc. IRE, vol. 50, no. 4, April 1962, p. 472.

HETERODYNE DETECTION IN OPTICAL COMMUNICATION
J. LaTourrette, et al. (editors), Technical Research Group, Syosset, N.Y., Technical note on Theoretical and Experimental Investigation of Broadband Coherent Optical Communication Techniques, Rept. no. TRG-168—TDR-1, RADC TDR 62-491, 30 Nov. 1962, 1 v., incl. illus., tables, refs., AD 296 362.

. . . using a LASER and a Twyman-Green interferometer. . . . preserves the signal-to-noise ratio in the detected difference frequency in the presence of incoherent noise. . . . demultiplexing of channels, demodulation of FM and AM, Doppler and displacement measurements, and stabilization of LASERs is discussed. . . .

PHOTOMIXING EXPERIMENTS WITH A RUBY OPTICAL MASER AND A TRAVELING-WAVE MICROWAVE PHOTOTUBE
B. J. McMurtry, et al., Appl. Optics, Suppl. 1, 1962, p. 133/136.

PHOTOMIXING EXPERIMENTS WITH A RUBY OPTICAL MASER AND A TRAVELING-WAVE MICROWAVE PHOTOTUBE
B. J. McMurtry, et al., Stanford Electronics Labs., Stanford U., Calif., Jan. 1962, 3 p., AD 400 084.

COHERENT LIGHT COMMUNICATION SYSTEMS UTILIZING A MICROWAVE BANDWIDTH PHOTON DETECTOR
M. Ross, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 1.5, Oct. 1962.

. . . the Dynamic Crossed Field Electron Multiplier (DCFEM) possesses the characteristics necessary for a coherent light communication system of microwave bandwidth. . . .

CONTINUOUS OPTICAL SUM FREQUENCY GENERATION (Correspondence)
N. I. Adams, et al., Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1366/1367.

Recent work has shown the feasibility of producing optical harmonics using a CW helium-neon gas phase maser as the input beam. Continuous generation of the optical sum frequency has now been achieved. . . .

INTERNAL NOISE AND SIGNAL-TO-NOISE RATIO OF A TUNED LASER AMPLIFIER
D. S. Bayley, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1111/1114.

If a laser preamplifier could be developed to have sufficiently low internal noise it would be possible to achieve nearly 100% quantum efficiency in optical receivers now limited, especially in the near IR region, by the low efficiency of available photo-emissive detectors. It is shown that under proper conditions such a low level of internal noise could be achieved in a tuned laser amplifier . . . design parameters of the amplifier . . . requirements on bandwidth and beamwidth . . .

OPTICALLY PUMPED IMAGE LIGHT AMPLIFICATION
H. Bernstein, et al., Electro-Optical Systems, Inc., Pasadena, Calif., Quarterly rept. no. 1, 10 May-10 Aug. 1963, Rept. no. 339001, Aug. 1963, 53 p., AD 415 361.

WIDEBAND MICROWAVE PHOTOTUBES FOR LASER COMMUNICATIONS SYSTEMS
D. J. Blattner, et al., Radio Corp. of America, Princeton, N. J., In RCA, Camden, N.J., Lasers, 1963, p. 27/28, refs., N64-12568.

RECEPTION OF SINGLE-SIDEBAND SUPPRESSED-CARRIER SIGNALS BY OPTICAL MIXING (Correspondence)
L. R. Bloom, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 610/611.

. . . a . . . receiving apparatus in which sideband signals can be demodulated by optically mixing them with a reinserted carrier in a photodetector. . . .

OPTICAL MASER DETECTION BY MICROWAVE ABSORPTION IN SEMICONDUCTORS
F. A. Brand, et al., IEEE Internat. Conv. Rec., vol. 11, no. 3, March 1963, p. 162/166.

RECEIVERS FOR LASER RADARS
W. B. Bridges, et al., Hughes Research Labs., Malibu, Calif., Interim engineering rept. no. 3, 15 May-14 Aug. 1963, 14 Aug. 1963, 27 p., AD 424 548.

THE TRAVELING-WAVE PHOTOTUBE. I-THEORETICAL ANALYSIS
D. E. Caddes, et al., IEEE Trans. Electron Devices, vol. ED-11, April 1964, p. 156/163, 12 refs., A64-17299.

DESIGN AND DEVELOPMENT OF A PHOTOMIXING DEVICE
D. E. Caddes, Sylvania Electric Products, Inc., Mountain View, Calif., Final rept., AFCRL 63 379, 9 Aug. 1963, 66 p., AD 422 961.

A traveling-wave phototube (TWP) has been developed which is capable of photomixing optical signals of differing frequency content and detecting the resultant difference frequency signal (beat) over the 11 to 20 Gc band. This represents the broadest bandwidth presently available in a practical photodetector. . . .

SEMICONDUCTOR LASER AMPLIFIER TECHNIQUES (SEMLAM)
F. J. Demma, General Electric Co., Syracuse, N. Y., Griffiss AFB, N.Y., Techniques Lab., RADC-TDR-63-429, Nov. 1963, 24 p., refs., AD 425 350, N64-12587.

CW SOLID STATE LASERS (NEW FREQUENCIES)
A. H. Gillmer, et al., Korad Corp., Santa Monica, Calif., Quarterly rept. no. 3, 1 Sept.-30 Nov. 1963, 30 Nov. 1963, 21 p., AD 430 858.

. . . LASER amplifier program . . . studying devices which amplify giant pulses. . . .

MAXIMUM GAIN FOR FORWARD AND BACKWARD WAVE OPTICAL MASER AMPLIFIERS
H. Jacobs, et al., Army Electronics Research and Development Agency, Fort Monmouth, N.J., AELRDL TR2375, July 1963, 26 p., AD 418 338.

. . . analysis . . . of the mechanism of amplification in a device consisting of three media. The first medium . . . air, the second . . . a crystal having a specific dielectric constant and distributed negative conductivity of constant value, and the third medium air . . . applied to the ruby optical maser . . .

THE OPTICAL HETERODYNE: KEY TO ADVANCED SPACE SIGNALING
S. Jacobs, Electronics, vol. 36, July 12, 1963, p. 29/31, A63-21484.

. . . with a laser system, for communications purposes. When information is carred on a monochromatic beam of light, optical heterodyning makes it possible to filter out and amplify only the bandwidth of interest—i.e., the information bandwidth. . . .

AMPLIFICATION AND GENERATION OF COHERENT LIGHT BY MEANS OF ELECTRON BEAMS (Correspondence)
H. H. Klinger, Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1367.

Smith and Purcell had observed that visible light is emitted from localized surface charges moving across a grating. The mechanism of this radiation can be explained by an energy transfer between a backward traveling wave and electrons moving across the grating, which may be regarded as a slow wave transmission line of periodic structure operating in the optical region of the spectrum. . . .

NONLINEAR EFFECTS CONVERT LASER BEAM, AMPLIFY LIGHT
W. Kornberg, Electronics, vol. 36, May 3, 1963, p. 30/32, A63-17865.

COHERENT LIGHT DETECTION IN SOLID-STATE PHOTODIODES
G. Lucovsky, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 166/172.

The operation of solid-state photodiodes as mixers of coherent light is discussed. Particular attention is given to the parameters that influence 1) frequency response, 2) quantum efficiency and 3) sensitivity. . . . Output mixed frequencies to 100 kMc can be obtained in appropriately designed structures. Experimental results verifying the existence of photomixing in Si, Ge, GaAs and InAs photobodies are presented.

PHOTOELECTRIC MIXING OF COHERENT LIGHT IN BULK PHOTOCONDUCTORS (Correspondence)
G. Lucovsky, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 613/614.

. . . in both photoemissive and solid-state junction devices . . . restricting . . . discussion to materials with one mobile charge carrier and ohmic contacts. . . .

AN EXPERIMENTAL PHOTOMIXER IMAGE TUBE
R. F. Lucy, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 162/165.

. . . for a superheterodyne receiver . . . for the detection of beats in the 2-4Gc region. This phototube incorporates an image dissector with a traveling-wave tube helix structure. It can be used to search an image field by electronic scanning for optical beats. . . .

PROPOSAL FOR BEATING TWO OPTICAL MASERS
G. D. Mahan, et al., J. Appl. Phys., vol. 34, May 1963, p. 1531/1534, 12 refs., A64-10663.

Proposition of an experimental arrangement with which two optical masers may be made to beat to produce a far-infrared source. The beating process occurs in a semiconductor which lacks inversion symmetry, allowing the third-order process. By selecting a semiconductor with an appropriate energy gap, the energy denominators in the matrix element may be made small, enhancing the infrared intensity. . . .

OPTIMIZED COHERENT OPTICAL RECEIVER TECHNIQUES
R. Ogrodnik, Sylvania Electric Products, Inc., Mountain View, Calif., Microwave Device Div., Griffiss AFB, N.Y., RADC, Tech. Branch, RADC-TDR-63-490, Dec. 1963, 27 p., refs., AD 428 379, N64-14352.

. . . initial tube design . . . utilizing an image dissector electron gun, together with an X-band slow-wave structure . . .

AFC OPTICAL HETERODYNE DETECTOR (Correspondence)
P. Rabinowitz, et al., Proc. IEEE, vol. 51, no. 5, May 1963, p. 857/858.

The frequency-modulated output of one He-Ne ($1.15\,\mu$) laser has been detected by using a second He-Ne laser as the local oscillator in an optical heterodyne detector. By automatic frequency control of the second laser, a stable intermediate frequency of 10.7 Mc $\pm$ 3 kc was generated, making possible the use of standard RF techniques for demodulation and detection of the FM signal. It is notable that the tracking accuracy was 1 part in 10^{11} of the laser frequency. . . .

ANALYSIS OF RECEIVING TECHNIQUES AND DEVICES FOR MICROWAVE BANDWIDTH COHERENT LIGHT COMMUNICATION SYSTEMS
M. Ross, IEEE Internat. Conv. Rec., Pt. 8, vol. 11, March 1963, p. 145/152.

. . . The techniques can be divided into two basic groups: photomixing and direct photodetection. The noise considerations and the system considerations are emphasized in comparison of the two techniques. Within each technique, various devices exist for use as the basic receiving elements. These devices are compared with emphasis on noise, gain, and bandwidth considerations and device applicability to particular system configurations. . . .

OPTICAL RECEIVING DEVICES
M. Ross, Electro-Technology, vol. 73, April 1964, p. 93/100, 11 refs., A64-16649.

Discussion of photon-effect optical receiving devices. These devices may be photo-emissive, photoconductive, photovoltaic, or photoelectromagnetic detectors or quantum amplifiers. Direct photodetection, which requires no local oscillator, and photo-mixing, which requires a local oscillator, are the receiving techniques employed in the operation of these receiving devices.

RECEIVING SYSTEMS FOR OPTICAL COMMUNICATIONS
M. Ross, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 447/456.

LASERS
J. Siddoway, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 212/215.

Considerations for the construction of a traveling wave laser amplifier were reported . . . in SPS 37-21, vol. IV. An amplifier tube has been completed, and evaluation and testing are now in progress. Single-pass gain of the gas is now 7 db.

OPTICAL AND INFRARED MASERS
J. Siddoway, et al., JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 137/148.

Traveling wave amplifier. . . . reported in SPS 37-23, vol. IV. The small signal gain of the system at 3.4 μ is 40 db for 12 passes of the laser beam. . . . optical system . . . shown in Fig. 7. It appears feasible to build a maser as a source of coherent radiation in the far infrared. The means of excitation is analogous to a heat engine.

AN ACTIVE INTERFERENCE FILTER AS AN OPTICAL MASER AMPLIFIER
V. N. Smiley, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 120/124.

Approximate theoretical expressions for gain, bandwidth, and root gain-bandwidth are derived by introducing negative absorption into equations for a Fabry-Perot interference filter. . . . Root gain-bandwidth is shown to be a constant for a given cavity as long as the cavity bandwidth is much smaller than the Doppler or fluorescent linewidth of the maser transition. Frequency shift due to temperature variations and the necessity for precise control of single-pass gain are two practical problems. These must be solved in order to make a stable amplifier with high gain.

DEMODULATION OF LOW-LEVEL BROADBAND OPTICAL SIGNALS WITH SEMICONDUCTORS
H. S. Sommers, Jr., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 140/146.

. . . the low impedance level of broadband circuits prevents high efficiency conversion of the incident power. Because of this, the envelope detector has a signal-to-noise ratio (SNR) which is determined by the noise of the following amplifier. As in radio communication, addition of a coherent optical signal from a local oscillator can increase SNR; however, for optical signals the limiting value of the noise figure is determined by the shot noise of the conversion current. Comparison with the limiting SNR expected from a photo-emission detector reveals no important distinction between them for frequency conversion. . . . photovoltaic and photoelectromagnetic solid-state device are analyzed . . .

THE TRAVELING-WAVE PHOTOTUBE. II-EXPERIMENTAL ANALYSIS
R. Targ, et al., IEEE Trans. Electron Devices, vol. ED-11, April 1964, p. 164/170, 6 refs., A64-17300.

PHOTOEMITTERS HAVING A HIGH QUANTUM EFFICIENCY (Correspondence)
R. M. White, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1662.

Interest in detectors for optical heterodyne communication system has resulted in realization of the need for photoemitters having high quantum efficiencies to permit obtaining high detection signal-to-noise ratios. It is the purpose of this note to point out a possibly forgotten reference to results which suggest means for constructing a photoemitter having a quantum efficiency approaching 0.5.

CW SOLID-STATE OPTICAL MASER (LASER)
Bell Telephone Labs., Inc., Murray Hill, N.J., 15 July 1962-15 July 1963, Final rept., 15 July 1963, 44 p., AD 431 601.

. . . High gain traveling-wave optical amplifier . . .

OPTIMIZED COHERENT OPTICAL RECEIVER TECHNIQUES
Sylvania Electric Products, Inc., Mountain View, Calif., RADC TDR63 490, Dec. 1963, 22 p., AD 428 379, AD 426 759.

. . . to develop a scannable photosensitive image detector capable of responding to modulation at a microwave rate. . . . utilizing an image dissector electron gun, together with an X-band slow-wave structure. . . .

SEMICONDUCTOR LASER AMPLIFIER TECHNIQUES (SEMLAM)
General Electric Co., Syracuse, N.Y., RADC TDR 63 553, Jan. 1964, 26 p., AD 430 340.

Related Publications:

LASECONS: MICROWAVE PHOTOTUBES WITH TRANSMISSION PHOTOCATHODES
D. J. Blattner, et al., IEEE Internat. Conv. Rec., vol. 11, no. 3, March 1963, p. 79/86.

SINGLE SIDEBAND MODULATION OF COHERENT LIGHT BY BRAGG REFLECTION FROM ACOUSTICAL WAVES (Correspondence)
H. Z. Cummins, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1246.

. . . This effect provides a simple method for shifting light frequencies in optical heterodyning or homodyning experiments and spatially separates the shifted component from the unshifted forward beam. . . .

OPTICALLY PUMPED IMAGE LIGHT AMPLIFICATION
F. M. Johnson, et al., Electro-Optical Systems, Inc., Pasadena, Calif., Quarterly rept. no. 2, 10 Aug.-10 Nov. 1963, Rept. no. 3990Q2, Nov. 1963, 28 p., AD 424 138.

A study was made of image intensification via the parametric optical amplifier. The physical processes associated with such an amplifier were examined in detail. These include material requirements, noise effects, the dispersive medium, the anisotropic induced polarization, refractive index matching, and crystal orientation. . . .

THE USE OF A LASER AMPLIFIER IN A LASER COMMUNICATION SYSTEM (Correspondence)
H. Steinberg, Proc. IEEE, vol. 51, no. 6, June 1963, p. 943.

INTERMODULATION DISTORTION IN GaAs INFRARED EMITTERS (Correspondence)
L. M. Vallese, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1252.

Recently Pankov and Berkeyheiser have described experiments of the modulation of GaAs infrared emitters. . . . aroused great interest in their utilization for communication links. For such applications, the study of the linearity of modulation is of basic importance. Distortion may be produced by nonlinearities associated with the input current-voltage characteristic and with the mechanism of photon emission. . . .

Section 3B.38

3B.380: Special Applications of Optronics

Included: Laser ranging methods; Laser satellite tracking methods; Utilization of coherent light.

Not Included: Complete optical ranging systems.

Cross References: Special applications of quasi-optical devices (3B.280); Applications in space communications (Div. 3B.4).

Principal Publications:

OPTICAL DATA PROCESSING AND FILTERING SYSTEMS
L. J. Cutrona, et al., IRE Trans. Inform. Th., vol. IT-6, no. 3, June 1960, p. 386/400.

ALL SKY SURVEILLANCE SYSTEM FOR SATELLITE DETECTION
P. H. Escher, et al., Electro-Optical Systems, Inc., Pasadena, Calif., AFCRL TR 60-407, 25 July 1960, 1 v., AD 246 037.

THE PULSED LIGHT THEODOLITE
L. A. Jay, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 35/36.

AN EXPERIMENTAL LASER RANGING SYSTEM
D. A. Buddenhagen, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 285/290.

FUNDAMENTAL LIMITATIONS TO OPTICAL DOPPLER MEASUREMENTS FOR SPACE NAVIGATION
R. H. Norton, et al., Proc. IRE, vol. 49, Nov. 1961, p. 1655/1659.

BREADBOARD COLIDAR (COHERENT LIGHT DETECTING AND RANGING) SYSTEM (Uncl).
M. L. Stitch, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 279/283.

The need for a high resolution ranging system for military applications has directed attention to the optical region of the spectra. . . .

THE NATURE OF ASTRO DOPPLER VELOCITY MEASUREMENT
J. E. Abate, IRE Trans. Space Electronics Telem., vol. SET-8, no. 1, March 1962, p. 50/56.

. . . The measurement yields the relative velocity of the vehicle with respect to a star, and requires the use of electro-optical systems capable of measuring a small incremental change in the wavelength of propagated stellar energy. Such systems provide velocity data whose character and limitations are a function of the star's spectral radiation as well as the system instrumentation.

METALLURIGICAL APPLICATIONS OF LASERS
C. J. Bahun, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 607/619.

HIGH POWER LASER FOR WELDING APPLICATIONS
G. W. Dunlap, et al., Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 601/606.

COMMENTS ON THE PROBLEM OF AN OPTICAL RADAR SYSTEM
R. K. H. Gebel, Aeronautical Research Lab., Office of Aerospace Research, Wright-Patterson Air Force Base, Ohio, Tech. rept. on Research on the Quantum Nature of Light, and Solid State Research and Properties of Matter, Rept. no. ARL 62-372, June 1962, 15 p., incl. illus., 3 refs., AD 278 640.

The need for optical radar equipment is discussed. . . . The usefulness of commercially available lasers is investigated. Solid state research providing new materials for laser-like devices is discussed.

A DOPPLER C. W. LASER SYSTEM USING OPTICAL HETERODYNING
W. Harmon, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 376/383.

. . . application of a Laser to determine the velocity between two space vehicles. The space medium is a high vacuum so electromagnetic radiation of any wavelength will be transmitted without attenuation.

INVESTIGATION OF OPTICAL CROSS-SECTIONS FOR LASER-RADAR
W. R. Rambauske, et al., Dayton Univ., Ohio, Research Inst., Rept. for 13 March 1961-1 March 1962, ASD TDR 62 726, 1 March 1962, 50 p., AD 422 055.

Areas for detailed investigation in the field of optical radar with a Laser light source were delineated. . . .

LASER APPLICATIONS PROGRAM AT HUGHES AIRCRAFT COMPANY
M. L. Stitch, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 375.

Summary.

PULSED HELIUM-NEON GAS LASER APPLICATIONS
L. L. Antes, et al., IEEE Trans. Mil. Electronics, Mil. Electronics, vol. MIL-8, no. 1, Jan. 1964, p. 3/12.

A RESEARCH PROGRAM ON THE UTILIZATION OF COHERENT LIGHT
L. Arons, et al., RCA Labs., Div., Radio Corp. of America, Princeton, N.J., Summary rept., April 1961-March 1963, ASD TDR 63 529, April 63, 120 p., AD 421 819.

. . . summarizes two years of work on the Utilization of Coherent Light Project. The report is relatively brief; for details the reader is referred to earlier progress reports and to the many published papers relating to work on this contract. . . .

THE LASER AS A TELEMETER (In French)
H. Bosc, Onde Electr., vol. 43, no. 436/7, July/Aug. 1963, p. 738/747.

. . . The laser, however, provides a simple solution to the problem of distance measurement up to a few kilometres. In this application it is already better than optical or radar telemeters. The article describes a laser telemeter whose practical realization was brought about by the Laboratoire Central des Telecommunications.

SOME APPLICATIONS OF OPTICAL MASERS IN SPACE RESEARCH AND TECHNIQUES (In French)
G. Broussaud, Onde Electr., vol. 43, no. 432, March 1963, p. 333/340.

The optical maser . . . may provide the preferred solution to a considerable number of problems which will arise from now onwards in the exploration of space . . . The examination is not in terms of current performances of masers already developed but in terms of those which we can reasonably hope to achieve in the near future.

GENERATION OF ACOUSTIC SIGNALS IN LIQUIDS BY RUBY LASER-INDUCED THERMAL STRESS TRANSIENTS (EFFECT OF ACOUSTIC BOUNDARY CONDITION ON IMPULSE SHAPE—E/T)
E. F. Carome, et al., Applied Physics Letters, vol. 4, March 15, 1964, p. 95/97, A64-15890.

OPTICAL COMMUNICATIONS EMPLOYING INFRARED EMITTING DIODES AND FM TECHNIQUES (Correspondence)
E. J. Chatterton, Proc. IEEE, vol. 51, no. 4, April 1963, p. 612.

NONDESTRUCTIVE LASER PUMPING BY HIGH EXPLOSIVES
J. K. Crosby, et al., Appl. Optics, vol. 2, Dec. 1963, p. 1339/1340, A64-11607.

Description of a technique which allows the light from an explosive light source to pump a laser material without destroying the material. The technique has been demonstrated by pumping a neodymium-doped glass laser from a distance of 3.5 m without damaging the laser. . . .

APPLICAZIONI DEI "MASER" OTTICI ALLE RICERCHE SPAZIALI (Applications of Optical "Masers" to Space Research) (In Italian)
G. Fiocco, Missili, vol. 5, April 1963, p. 73/78, A63-21457.

USE OF OPTICAL MASERS IN DISPLAYS AND PRINTERS
H. Fleisher, et al., International Business Machines Corp., Poughkeepsie, N.Y., Quarterly rept. no. 1, 7 Jan.-6 April 1963, 37 p., AD 406 311.

. . . to develop laser technology for computer input output devices, and to prepare a laboratory type demonstration to indicate the ability modulate electronically and deflect a light beam . . . The conclusion indicates that digital electro-optic deflection of intense light beams is feasible and could lead to the realization of practical laser display and printing apparatus.

USE OF OPTICAL MASERS IN DISPLAYS AND PRINTERS
H. Fleisher, et al., International Business Machines Corp., Poughkeepsie, N.Y., Quarterly rept. no. 2, 7 April-6 July 1963, 10 Sept. 1963, 35 p., AD 417 500.

High-speed deflections of light beams by digital and analog techniques were investigated. For the digital light deflector, power consumption was determined, semitransparent electrodes were evaluated . . . a bread-board model was constructed.

USE OF OPTICAL MASERS IN PRINTERS AND DISPLAYS
H. Fleisher, et al., IBM Corp., Poughkeepsie, N.Y., Final rept. 7 July-6 Oct. 1963, Rept. no. 3, 6 Oct. 1963, 79 p., AD 428 610, AD 432 297.

ANALYSIS AND OPTIMIZATION OF LASER RANGING TECHNIQUES
G. W. Flint, IEEE Trans. Mil. Electronics, vol. MIL-8, no. 1, Jan. 1964, p. 22/28.

The general criteria for the operational performance of laser ranging systems are considered in quantitative terms with emphasis being placed on the optimization of systems which must meet specific operational requirements. . . . detailed discussion of all contributing noise sources . . . a technique is proposed whereby the resolution is varied as a function of target return. This technique employs a multiple pulse transmitter and automatically optimizes its resolution and range capabilities.

THE LASER AND ITS APPLICATION TO METEOROLOGY
G. G. Goyer, et al., Bull. Amer. Meteorol. Soc., Bulletin, vol. 44, Sept. 1963, p. 564/570, 22 refs., A63-23904.

. . . when using the laser for meteorological investigations, the choice of wavelength is restricted by atmospheric and particulate absorption, solar background radiation, and, in the far IR, by the suitability of the optics, the light amplifiers, and the available detectors. . . .

A FEASIBILITY STUDY OF AN OPTICAL RANGING DEVICE FOR SPACE VEHICLES
A. J. Hallisey, et al., Massachusetts Inst., of Tech., Cambridge, June 1963, 73 p., AD 407 990.

. . . conclusion that optical ranging with high intensity, short duration light beacons is indeed feasible.

DOPPLER OPTICAL NAVIGATOR
W. J. Hannan, et al., RCA Defense Electronic Products, Camden, N.J., Quarterly progress rept. no. 1, 19 Sept. 1963, 62 p., AD 420 000.

The feasibility of novel laser techniques for Doppler optical navigation is discussed. . . .

LASERS FOR RANGING APPLICATIONS
E. Kornstein, Radio Corp. of America, Burlington, Mass., Aerospace Communications and Controls Div., In RCA, Camden, N. J., Lasers, 1963, p. 16/19, refs., N64-12564.

TELEVISION PHOTOGRAPHY OF THE MOON
N. F. Kuprevich, Joint Publications Research Service, Washington, D. C., JPRS-20223; OTS-63-31315, 18 July 1963, 11 p., refs., Transl. into English of an article from Priroda, Moscow, no. 4, 1963, p. 90/93, N64-11222.

. . . In photographing the image of the moon in the infrared region, using the television system, a series of transformations occurs. A block diagram of the television telescope with infrared vidicon is given.

PORTABLE LASER RANGEFINDER: BATTERY SELECTION CRITERIA
J. T. Lehman, Army Ordnance Arsenal, Philadelphia, Pa., Test rept. no. T63-6-1, Jan. 1963, 13 p., AD 298 170.

ALL-ELECTRONIC DATA INPUT-OUTPUT STUDY
W. E. Lepper, National Scientific Labs., Inc., Washington, D. C., Quarterly progress rept. no. 2, 1 Oct.-31 Dec. 1963, AD 432 988.

. . . proposed use of lasers in printout equipment . . . of the effects of laser energy on papers of several types are described.

AEROSPACE, MILITARY LASER USES EXPLORED
B. Miller, Aviation Week and Space Technology, vol. 78, April 22, 1963, p. 54/55, A63-16493.

Survey of the present and anticipated funding for development of the laser as a communications and detection device . . . The name of the contractor, the supporting agency, and the dollar value of each program are included.

EFFECTS OF THE LASER BEAM
D. V. Missio, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 569/573.

Pulsed ruby lasers have been used to perforate various targets. The relationship between various parameters of the laser device and the nature of the target and the resulting hole will be discussed. Some of the parameters found to influence the drilling capability are peak power, pulse length and power density . . .

THE S-66 LASER SATELLITE TRACKING EXPERIMENT
H. H. Plotkin, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., Feb. 13, 1963, 24 p., refs., Presented at 3rd Intern. Conf. on Quantum Electron., Paris, Feb. 13, 1963, N64-10108.

ON THE POSSIBILITY OF SIMULATING METEOROID IMPACT BY THE USE OF LASERS
W. J. Rae, et al., Cornell Aeronautical Lab., Inc., Buffalo, N. Y., Topical Report, CAL-AI-1821-A-1, April 1964, 44 p., refs., N64-19788.

. . . The characteristics of the light output from a laser allow a strongly focused pulse of energy to impinge on the target surface . . .

A PULSE MODULATION APPLICATION OF THE GALLIUM ARSENIDE LIGHT EMITTING DIODE (Correspondence)
G. R. Seashore, Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1781.

This communication describes a relatively simple method for measuring the transient response parameters of silicon photo detectors. It is based on the modulation capabilities of a gallium arsenide light emitting diode as reported earlier by Pankove and Berkeyheiser and more recently by Quine, Tomiyasu, and Younger. . . .

LASER MISSILE TRACKER
E. P. Snyder, Ordnance, vol. 48, Jan.-Feb. 1964, p. 447/448, A64-13793.

. . . requirements of a modulated-power continuous-wave optical system for tracking the target, measuring elevation and azimuth angles and range, and sending and recording data. It is designed to measure the position of a rocket or missile at very high accuracies from launch to 50,000 ft.

LASER APPLICATIONS FOR SHORT RANGE WEAPONS CONTROL
G. Taylor, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 165/168.

LASER-ALLOYED TUNNEL DIODES FOR MICROWAVE APPLICATIONS (Correspondence)
L. Wandinger, et al., Proc. IEEE, vol. 51, no. 6, June 1963, p. 938/939.

. . . The very high energy output of a ruby laser offers distinct advantages over the conventional strip-heater alloying techniques for the microalloying of extremely abrupt p-n junctions. . . .

THE LASER AS A MACHINE TOOL
D. L. Williams, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 574/587.

THIN FILM LASER COUNTER
J. T. Winkler, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 764/767.

A thirteen substrate, nine cubic inch, high frequency counter utilizing hybrid thin film logic has been designed and demonstrated. The major design phases and trade-offs to meet the requirements of a man-portable laser ranging device will be presented . . .

THIN FILM LASER COUNTER
J. T. Winkler, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 793.

a 13-substrate, 9-cubic inch, 30 mc counter utilizing hybrid thin film logic has been designed and demonstrated. . . . (Abstract only.)

Related Publications:

EXPERIMENTAL VERIFICATION OF SUN-POWERED LASER TRANSMITTER
D. A. LaMarre, American Optical Co., Southbridge, Mass., Interim engineering rept. no. 1, July 1962, 43 p., AD 437 865.

The feasibility of using four-level laser materials is investigated. A general expression is derived for the figure of merit "G" of a four-level laser in the sun-powered end-pumped configuration. . . .

EXPERIMENTAL VERIFICATION OF SUN POWERED LASER TRANSMITTER
D. A. LaMarre, et al., American Optical Co., Southbridge, Mass., Interim engineering rept. no. 2, Aug.-Nov. 1962, Nov. 1962, 41 p., AD 437 864.

. . . design leading to the delivery of an experimental model of a sun-powered laser transmitter. . . . Experimental Nd-doped glass lasers are discussed in both the short- and long-fiber configurations.

SPACE COMMUNICATIONS BY THE USE OF LASERS: AN ENUMERATIVE BIBLIOGRAPHY
P. L. Simmons, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 449/456, 379 refs.

. . . traces the history of lasers in relation to communication and other applications from their inception to early 1962. Documentation includes books and periodicals including foreign language research.

QUANTUM GENERATORS AND "DEATH RAYS"
P. T. Astashenkov, Joint Publications Research Service, Washington, D. C., JPRS-20959; OTS-63-31696, Sept. 6, 1963, 16 p., Transl. into English of an article from At. Radiotekhn; Moscow, 1962, p. 77/89, N63-21026.

. . . creation of monochromatic light sources which make it possible to obtain beams of radiation which are as sharply directed as needles, and to generate temperature effects equal to 10^{100} C. These particular characteristics are discussed in terms of developing methods and instruments for local and space communication systems, space navigation, location and range finders, and for producing death rays which are to be used in a defense system against missile attack.

CLASSICAL THEORY OF THE DIRAC ELECTRON
Z. Grossmann, et al., Society of Automotive Engineers, Automotive Engineering Congress, Detroit, Mich., Jan. 13-17, 1964, Paper 816B, 6 p., A64-12073.

Review of the experimental procedure used in generating very high intensity pulsed laser beams. This is followed by a discussion of the experiments to date using these high intensity beams to observe electrical breakdown at optical frequencies and nonlinear optical effects. Possible applications are also discussed briefly.

ACTIVE IMAGING
W. A. Hardy, Nature, vol. 202, April 18, 1964, p. 277/278, A64-17334.

Application of the mode degeneracy of an optical cavity to image formation in the sense that opaque objects placed before the mirror control the resultant field distribution in maser oscillations. In turn, the light generated within the cavity and partially transmitted through one mirror is used to re-image the object. Specific attention is directed to the fact that such images may have a contrast or resolution an order of magnitude greater than would be obtained by conventional diffraction-limited image formation.

INJECTION-LASER SYSTEMS FOR COMMUNICATIONS AND TRACKING
C. M. Johnson, Electronics, vol. 36, Dec. 13, 1963, p. 34/39, 16 refs., A64-11737.

INTERFERENCE FRINGES PRODUCED BY SUPERSITION OF TWO INDEPENDENT MASER LIGHT BEAMS
G. Magyar, et al., Nature, vol. 198, 20 April 1963, p. 255/256, 17 refs., A63-17245.

NBS LASER PRODUCES INTERFERENCE FRINGES OVER 200-METER OPTICAL PATH
Technical News Bulletin, vol. 47, May 1963, p. 80/82, A63-17540.

DIVISION 3B.4
OPTICAL COMMUNICATIONS SYSTEMS

The vital subsystems and components of optical communication systems are referenced in division 3B.3. This division is concerned with the systems aspect and the first three sections contain, as in other divisions, the general references, the theoretical background including propagation (3B.41) and significant engineering problems (3B.42). The section on special techniques (3B.43) deals with pulsed light communications, with solar communications systems and with retro-reflective optical communication ideas.

It is a characteristic feature of the present state of development that there were not more publications available at the end of 1963 in the system area. Accordingly the reader will find only two subdivisions for optical communications systems in two special wavebands: Infrared (3B.472) and ultra-violet (3B.473).

Section 3B.40:

3B.400: Optical Communications Systems

Included: Optical pipelines; Light modulated data links; Optical space communications; Interplanetary optical communications links; Earth-space laser links; Laser communications systems.

Not Included: Interstellar communications (4C).

Cross References: Optical ranging methods (3B.380); Optical transmitters (3B.350); Optical receivers (3B.370); Lasers (Sect. 3B.34).

Principal Publications:

OPTICAL COMMUNICATION DURING HYPERSONIC RE-ENTRY
E. Langberg, IRE Trans. Commun. Syst., vol. CS-7, June 1959, p. 68/70.

LIGHT AS INFORMATION CARRIER IN SPACE COMMUNICATION SYSTEMS
K. W. Otten, Proc. Nat. Commun. Symp., vol. 6, Oct. 1960, p. 44/50.

OPTICAL COMMUNICATION BETWEEN A RE-ENTRY VEHICLE AND THE EARTH. PART I
S. Sherman, General Precision Lab., Inc., Pleasantville, N. Y., Rept. no. A24-1, RADC TN 61-42A, Dec. 1960, AD 256 704.

. . . includes an extended source, modulator, and transmitting mirror for each transmitting system, the atmosphere as a transmission medium, and a receiver mirror, filter, and detector for each receiving system. . . .

LIGHT: A NEW COMMUNICATION MEDIUM
G. C. Dacey, Control Engng., vol. 8, no. 9, Sept. 1961, p. 147/149.

LASERS: DEVICES AND SYSTEMS - PART II
L. Dulberger, et al., Electronics, vol. 34, no. 44, Nov. 1961, p. 40/44.

Communications in space, on earth and undersea may soon make use of lasers. . . . A review of "futuristic" laser communications techniques. Good bibliography.

OPTICAL COMMUNICATIONS
G. Jacobs, Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 157.

. . . theoretical system performance, experimental results and novel construction details of an optical communications system intended to explore the problems of wide band, ground-to-ground optical communications.

FLASHING LIGHT ENCODERS
L. A. Jacobson, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. 312G-1, 27 Nov. 1961, 20 p., AD 269 558.

Transmission of data from sub-orbital vehicles is accomplished primarily through the use of RF telemetry methods. One suggested approach to assure data transmission during a RF blackout employs a supplementary flashing light transmitting system. In this system the flashing light encoder has the assignment of transforming data information imposed on a group of FM sub-carrier channels into a form compatible with a flashing light transmitter. The encoder samples the frequency in X-channels and converts each frequency into a time interval between two flashes. The coincidence of the start of one sample with the termination of the previous sample provides for maximum efficiency in the utilization of time and power.

FEASIBILITY OF SPACE COMMUNICATIONS USING OPTICAL MASERS
W. V. Rusch, et al., JPL Res. Summ., no. 36-8, Feb./March 1961, p. 39/41.

. . . Comparison of RF and optical systems . . . Laser characteristics . . . Optical transmitter antenna . . . Receiver antenna gain . . . System temperature . . . The RF system . . . Conclusions . . . Consequently, quite aside from such extremely difficult problems as pointing and efficiency, the optical systems do not, at present, appear to promise any advantage over conventional RF systems for deep space tracking and communications. However, since this situation may change drastically because of unforeseen developments, this problem will be reviewed periodically. . . .

INTERSTELLAR AND INTERPLANETARY COMMUNICATION BY OPTICAL MASER
R. W. Schwartz, et al., Nature, no. 190, April 1961, p. 205/208.

PRINCIPAL USES OF COHERENT LIGHT
H. Bosc, Elect. Commun., vol. 37, no. 4, 1962, p. 360/366.

OPTICAL PIPELINE: A TENTATIVE ASSESSMENT
C. C. Eaglesfield, Proc. Instn. Elec. Engrs., vol. 109, no. 43, Jan. 1962, p. 26/32.

. . . study . . . of transmission at optical wavelengths through a hollow steel pipe the inner surface of which has a mirror finish. . . .

OPTICAL COMMUNICATIONS: A BIBLIOGRAPHIC SURVEY OF POSSIBLE SPACE AND TERRESTRIAL APPLICATIONS OF THE LASER AND MASER
J. B. Goldmann (comp.), Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliography no. SB-62-7, Rept. no. 3-77-62-4, March 1962, 54 p., 157 refs., AD 275 591.

. . . annotated bibliography included publications released from 1959 through February 1962. . . .

A LASER DESIGN FOR SPACE COMMUNICATIONS
L. Goldmuntz, IRE Internat. Conv. Rec., Pt. 5, vol. 10, March 1962, p. 298/305.

. . . A LASER communication system . . . has many advantages and disadvantages. . . . optical beam must be space stabilized to seconds of arc. . . . earth station must be spaced in such a climate or at such an altitude that the probability of clear weather is large. The attenuation of an optical signal in a heavy fog is 300 db/kilometer.
. . . some rough performance characteristics in various missions for simple LASER systems utilizing both incoherent and coherent detection. . . .

LICHT ALS NACHRICHTENTRAGER (Light As Information Carrier) (In German)
R. Hubner, Funk-Technik, no. 5, March 1962, p. 147/148.

OPTICAL-BAND RADIO COMMUNICATION
D. G. C. Luck, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 346/351.

APPLICATION OF LASERS TO DIGITAL COMMUNICATIONS
D. D. Matulka, IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 2, June 1962, p. 104/109.

Revolutionary developments taking place in the field of light generation show promise of providing a means for transmitting digital information over vast distances in space at extremely high rates. . . . brief description of LASER operation . . . applicability of the device to certain aerospace vehicular digital communications requirements. An earth-moon link is analyzed from the standpoint of beamwidth, power, and aiming requirements. It is shown that a system utilizing a coherent optical transmitter of less than 1 w and a conventional photodetector would be capable of transmitting digital information over this link at megacycle rates. . . . Improvements which can be made on this rather simple system by increasing bandwidth and improving detection efficiency, tracking accuracy, and LASER techniques are pointed out. . . .

SOME POTENTIALITIES OF OPTICAL MASERS
B. M. Oliver, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 207/222, A64-10232.

Presentation of the possibilities offered by optical masers in several areas, particularly in the field of space communication. . . .

RADIO AND OPTICAL SPACE COMMUNICATIONS
R. D. Potter, et al., JPL, Calif., Inst. of Tech., Pasadena, Calif., JPL-TM-33-85, Presented at the Sixth Meeting of the AGARD Avionics Panel, Paris, July 6-12, 1962, Oct. 30, 1962, 22 p., 38 refs., N63-17336.

The theory and state-of-the-art of laser sources is reviewed with the possible application of these devices to space communications and long-range radar (or lidar). Sample optical and radio-frequency systems are analyzed in detail. Practical system and component problems which arise in optical communication and lidar systems are discussed.

INVESTIGATION OF OPTICAL SPECTRAL REGIONS FOR SPACE COMMUNICATIONS
R. A. Rollin, Jr., Institute of Science and Tech., U. of Michigan, Ann Arbor, Interim rept. no. 2, 1 May-31 July 1962, Rept. no. 4968-2-P, Nov. 1962, 188 p., incl. illus., tables, 65 refs., AD 287 640, AD 278 215.

An analysis is presented of space communications systems in the optical spectrum (wavelengths of 0.2 to 100 microns). Background interference . . . literature search on transmitter and receiver components . . .

derivation of the general optical systems range equation and equations for the maximum theoretical range of optical communications and the maximum theoretical channel capacity. . . . photocathode-type and . . . photoconductive-type quantum detectors. . . . literature on optical transmitter modulators and modulation techniques and on optical-system lenses and reflector-aperture characteristics. . . .

SPACE COMMUNICATIONS BY THE USE OF LASERS: AN ENUMERATIVE BIBLIOGRAPHY
P. L. Simmons, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 449/456.

. . . traces the history of lasers in relation to communication and other applications from their inception to early 1962. Documentation includes books and periodicals including foreign language research. 379 references.

A RESEARCH PROGRAM ON THE UTILIZATION OF COHERENT LIGHT
D. J. Blattner, et al., David Sarnoff Research Center, Princeton, N. J., Interim rept. no. 6, 1 Oct.-31 Dec. 1952, 20 Jan. 1963, 28 p., incl. illus., 11 refs., AD 296 145.

. . . demonstration of an optical maser communications system carrying an audio channel. . . .

A LIGHT-MODULATED DATA LINK
B. A. Boerschig, IEEE Trans. Broadcasting, vol. BC-10, Feb. 1964, p. 4/7, 7 refs., A64-15269.

. . . The advantages of the GaAs junction diode as the modulated light source and the advantages of operating the diode in the laser mode are considered. A derivation of the received power as a function of the beam angle and range is given. Considerations in the selection of the photopickup device and its relative merits are presented.

STUDY ON OPTICAL COMMUNICATIONS FROM DEEP SPACE
K. L. Brinkman, Hughes Aircraft Co., Culver City, Calif., Interim Progress Report, 7 Nov. 1962-7 Jan. 1963, 1963, 97 p., refs., N64-17692.

. . . a comparison between microwave and optical communication systems . . . optical transmission considerations, antenna system gain . . . transmitter package weight . . . system noise . . . optical maser technology . . . optical detector technology . . . modulation and demodulation techniques . . .

STUDY ON OPTICAL COMMUNICATIONS FROM DEEP SPACE
K. L. Brinkman, Hughes Aircraft Co., Culver City, Calif., Interim Progress Report, 7 Jan.-1 Feb. 1963, 1963, 50 p., refs., N64-16711.

A preliminary survey of operating lasers and their characteristics is presented. Particular emphasis is placed upon CW operating lasers (solid state and gas), the properties of the gallium arsenide lasers, and solar pumped lasers . . . their use as optical communications systems components . . . Bibliographies on the following subjects are presented: laser materials and devices; modes and optical properties of laser emission; modulation mixing, detection, etc.; and theory, pumping and miscellaneous considerations.

STUDY ON OPTICAL COMMUNICATIONS FROM DEEP SPACE
K. L. Brinkman, Hughes Aircraft Co., Culver City, Calif., Space Systems Div., Interim Progress Report, 1 Feb.-27 March 1963, 1963, 119 p., refs., N64-16727.

The modulation and demodulation task is fully reported in this volume . . . examination of wide bandwidth systems with the goal of providing real-time TV capability . . . utilizing such capability at these extreme ranges is strongly dependent on the state-of-the-art of other system parameters. As a result, techniques for providing narrower bandwidth are also discussed. A treatment of atmospheric attenuation studies is given. This is followed by a discussion of the extremely important pointing problem, the result of which is seen to have considerable impact on the design bandwidth . . . discusses the advantages and disadvantages of the various communication links.

LASER AND COHERENT OPTICAL RADIATION
S. Deb, et al., J. Sci. Indust. Res., vol. 22, Aug. 1963, p. 314/334, 155 refs., A63-26033.

. . . recent developments in the field of lasers. . . . performance of various types of resonators used in the optical range . . . possible scientific and technological applications. . . .

A COMPARISON OF RADIO AND OPTICAL COMMUNICATIONS
J. F. Honey, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 331/341, 15 refs.

. . . a brief introduction to optical communication problems in terms familiar to the radio communications engineer. . . . photon or radiation noise environment at IR, visible and higher frequencies . . . desirability of wideband modulation techniques. Communication range equations . . .

MODULATED INFRARED DIODE SPANS 30 MILES
R. J. Keyes, et al., Electronics, vol. 36, April 5, 1963, p. 38/39, A63-14944.

Description of a communications experiment with a gallium arsenide diode transmitting audio and visual signals over a 30 nautical mile path, with 8,400 Å emission. The experiment demonstrates the ability of the GaAs diode to function as a long-distance communications device during good weather.

NEKOTORYE VOPROSY GENERATSII OPTICHESKOGO IZLUCHENIIA (Some Problems Associated With The Generation Of Optical Radiation) (In Russian)
O. N. Krokhin, Akademiia Nauk SSSR, Vestnik, Aug. 1963, p. 62/69, A63-25412.

. . . Examined are problems associated with the realization of new concepts in the generation, modulation, and reception of coherent optical radiation. Also examined are the problems involved in the design of new lasers to operate at certain frequency bands, and in the development of techniques to improve laser performance and characteristics.

APPLICABILITY OF LASER TECHNIQUES
W. S. Litchman, ITT Communication Systems, Inc., Paramus, N. J., Rept. no. 64TR379, ESD TDR 64 249, 13 March 1964, 80 p., AD 434 378.

Laser communications techniques are presented that can be integrated into the AIRCOM System to satisfy unmet current and estimated future AF requirements. . . . Although the laser will have a great impact in certain areas of communications technology, its potential in any specific area must be carefully evaluated.

TRANSMITTERS AND RECEIVERS FOR OPTICAL COMMUNICATIONS
J. R. McDermott, Space/Aeronautics, vol. 39, June 1963, p. 98/106, 38 refs., A63-18060.

. . . optical transmitters using a CW helium-neon laser for microwave modulation of the beam . . . optical antenna as the beam-forming optics . . . General Telephone's optical transmitter-receiver system for TV-video signal transmission by microwave modulation of the laser beam.

Noted are the use of the Pockels-effect microwave modulating cavity for microwave modulation, and the application of the superheterodyne principle to the reception of advanced types of modulation.

RADIO AND OPTICAL SPACE COMMUNICATIONS
P. Potter, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, In Agard, Paris Light and Heat Sensing, 1963, p. 235/262, refs., N64-15470.

. . . theory and state-of-the-art of laser sources is reviewed, and the possible application of these devices to space communications and long-range (or lidar) is discussed. Sample optical and radiofrequency systems are analyzed in detail. Practical system and component problems that arise in optical communication and lidar systems are discussed.

INVESTIGATION OF OPTICAL SPECTRAL REGIONS FOR SPACE COMMUNICATIONS
R. A. Rollin, Jr., Institute of Science and Tech., U. of Michigan, Ann Arbor, Final rept., Feb. 1962-Jan. 1963, ASD TDR63 185, May 1963, 253 p., AD 410 537.

. . . derivation of the range equation was refined. The performance of seven systems were compared. Coherent laser sources were found to be superior to conventional sources. A literature search on transmitter and receiver components . . . Background interference was investigated. The solar noise experiment is reported and described.

INTERSTELLAR AND INTERPLANETARY COMMUNICATION BY OPTICAL MASERS
R. N. Schwartz, et al., In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 223/231, 10 refs., A64-10233.

. . . the possibility of developing maser oscillators and other apparatus in or near the optical region which will allow the beaming of detectable light signals between planets of two stars separated by a number of light-years. The chance that broadcasts from another society approximately as advanced as we are could be detected by present telescopes and spectrographs is discussed, together with appropriate techniques now available for detection. . . .

RESEARCH REQUIREMENTS FOR FUTURE MANNED SPACE FLIGHT COMMUNICATIONS
J. M. Walker, In: 2nd Manned Space Flight Meeting, New York, American Institute of Aeronautics and Astronautics, 1963, p. 17/22. A63-18984.

. . . emphasizing . . . increasing the information received by spacecraft. . . . increasing the antenna sizes, and using lasers. Described is the S-66 laser tracking experiment which is to be an initial step in providing many of the basic facts needed before optical technology may be brought to bear on the problems of space communications and tracking. . . . approaches to minimizing the blackout period . . .

THE LASER
A. Yariv, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 4.

. . . sections on optical resonators and communications . . . conclude the paper . . .

coincide with traditional areas of interest of microwave and communications engineers.

OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY. VOLUME II: SYSTEM TOPICS — PART ONE
General Electric Co., Philadelphia, Pa., Valley Forge Space Technology Center, Final Report, 7 Feb. 1964, 97 p., refs., N64-18132.

. . . effects of the atmosphere on laser propagation. The study supported the belief that optical communication has the potential to replace radio and to perform unique functions in many space situations . . .

OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY. VOLUME III: SYSTEM TOPICS - PART TWO
General Electric Co., Philadelphia, Pa., Valley Forge Space Technology Center, Final Report, 7 Feb. 1964, 123 p., refs., N64-18133.

. . . laser optics-transmitting optics, receiving optics, filtering, and detection of faint sources.

OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY. FINAL SYSTEMS STUDY
General Electric Co., Philadelphia, Pa., Missile and Space Div., Vol. IV, Final Report, 3 March 1964, 34 p., refs., N64-18442.

It was found that optical communication in space offers a remarkable potential for efficient data transmission. This potential is about 60 db better than can be achieved by radio . . . specification of the work that must be done to realize a useful potential are discussed . . . The system would be capable of providing real-time television transmission from the range of Mars with a transmitted power of about 1 watt . . .

NASA STUDIES EARTH-SPACE-EARTH LASER LINKS
Electronics, vol. 36, May 10, 1963, p. 22/24, A63-16925.

. . . if the light source is a laser, it is feasible to have such systems, in which a complete tracking loop is closed by human operators and/or servomechanisms. Future developments of these systems are considered, including the upcoming laser tracking experiments with the S-66 satellite and a new program for developing electro-optical methods of steering laser beams.

Related Publications:

PROJECT LUNA SEE (Correspondence)
L. D. Smullin, et al., Proc. IRE, vol. 50, no. 7, July 1962, p. 1703/1704.

. . . to determine some of the possibilities of optical maser radar we conducted experiments with the Moon as a target. . . .

QUANTUM GENERATORS AND "DEATH RAYS"
P. T. Astashenkov, Joint Publications Research Service, Washington, D. C., JPRS-20959: OTS-63-31696, Sept. 6, 1963, 16 p., Transl. into English of an article from At. Radiotekhn., Moscow, 1962, p. 77/89, N63-21026.

. . . creation of monochromatic light sources which make it possible to obtain beams of radiation which are as sharply directed as needles, and to generate temperature effects equal to 10^{10}°C. These particular characteristics are discussed in terms of developing methods and instruments for local and space communication systems, space navigation, location and range finders, and for producing death rays which are to be used in a defense system against missile attack.

FUTURE RESEARCH ON INTERSTELLAR COMMUNICATION
A. G. W. Cameron, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 309/315, A64-10241.

Discussion of certain fields of research that can contribute in a more direct way to guesses about the nature of extraterrestrial societies. The nearest communicative civilization should be expected to be about 87 parsecs away (284 light-years). For civilizations on planets near the very faint stars, which have been proposed as likely to exist, the laser may be the obvious way of communicating, since the signal-to-noise ratio of their optical transmissions should be orders of magnitude better than that calculated for the Sun by Schwartz and Townes.

FEASIBILITY OF A LUNAR OPTICAL RANGING EXPERIMENT
R. L. Iliff, et al., Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 908, Dec. 1963, 24 p., AD 434 586.

. . . using a high energy pulsed laser . . . giving special attention to the required minimum return signal, interfering radiation, detector devices, and pulse length.

LASER CHARACTERISTICS AND SOME POTENTIAL APPLICATIONS
D. Karlsons, et al., Radio Corp. of America, Camden, N. J., Defense Electronics Products, In its Lasers, 1963, p. 20/22, refs., N64-12565.

Favorable and unfavorable laser characteristics that affect applications, current trends and needs in laser equipment development and potential laser applications are discussed . . . High noise temperatures, very difficult propagation characteristics for application through the earth's atmosphere, and rather poor efficiencies are all disadvantages of the laser. Some of the applications of the laser are as amplifiers; as a power generator capable of very-high-peak outputs; as well as average power levels; as detectors; in communication systems; and in radar systems . . .

LASER TECHNOLOGY: AN ANNOTATED BIBLIOGRAPHY
H. B. McCormick (comp.), Lockheed Aircraft Corp., Sunnyvale, Calif., Rept. no. 5 73 63 6, SB 63, Feb. 1963, 91 p., AD 431 290.

Advances in laser technology . . . new materials . . . laser applications . . . continuing research . . . from January 1962 through February 1963. Subject coverage is selective representation rather than complete. . . .

EXTRATERRESTRIAL INTELLIGENT LIFE AND INTERSTELLAR COMMUNICATION: AN INFORMAL DISCUSSION
J. P. T. Pearman, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 287/293, A64-10238.

. . . the number of civilizations becomes 10^5 to 10^9, and the distance of the nearest civilization is estimated at ten to a few hundred light-years. The use of radio or other electromagnetic signals appears to be the only method accessible for interstellar communication. Straightforward detection of "intelligent" transmissions seems to hold more promise than establishing two-way communication. . . . the use of lasers does not appear to be advantageous over interstellar distances, and, in the radio spectrum, the region from 10 to 30 kMc seems to be preferable for maximizing the signal-to-noise ratio. . . .

Section 3B.41: Theory of Optical Communications Systems

3B.410: General Reviews of Optical Systems Theory

Included: Performance criteria; Performance predictions; Fundamentals of optical communications systems; Comparison of various optical communications systems; Analytical systems descriptions.

Not Included: Theory of space communications links.

Cross References: Theoretical analysis of light communications systems (3B.411).

Principal Publications:

OPTICAL COMMUNICATION. I.
D. S. Bayley, General Precision Lab., Inc., Pleasantville, N. Y., Rept. A24-2, RADC TN 61-117, May 1961, 340 p., AD 261 583.

. . . potentials of optical maser, radio and conventional optical communication systems are compared. Optical maser systems of voice channel capacity for communication between two ground stations linked by a passive, diffusely reflecting satellite and between the earth and a re-entry vehicle are analyzed in sources . . . demonstrate that conventional optical sources are unsuitable for use in the system.

OPTICAL COMMUNICATIONS
G. Jacobs, Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 157.

. . . theoretical system performance, experimental results and novel construction details of an optical communications system intended to explore the problems of wide band, ground-to-ground optical communications.

SOME FACTORS AFFECTING APPLICABILITY OF OPTICAL-BAND RADIO (COHERENT LIGHT) TO COMMUNICATION
D. G. C. Luck, RCA Rev., vol. 22, no. 3, Sept. 1961, p. 359/409.

AN INITIAL ASSESSMENT OF COMMUNICATION SYSTEMS AT OPTICAL FREQUENCIES
A. W. Smith, et al., Defense Research Telecommunications Establishment (Canada), DRTE rept. no. 1071, June 1961, 15 p., 41 refs., AD 259 932.

Preliminary evaluation of communication and radar systems at optical and near infrared frequencies is presented. The existence of a large body of proven optical techniques, and the advent of the optical maser, makes such frequencies more attractive in many ways than millimeter wave frequencies. The present state of optical masers, modulators and receivers is reviewed. Possible applications both on the earth's surface and in space are considered in some detail. . . . It is concluded that the natural application of such systems is for space communications. Tentative suggestions for research are made.

SPECTRAL SUITABILITY, MODULATION AND DETECTION TECHNIQUES IN COMMUNICATION WITH WAVELENGTHS BETWEEN 30 AND 10,000 ANGSTROMS, PART I.
D. S. Bayley, et al., General Precision Lab., Inc., Pleasantville, N. Y., Final rept., rept. no. A24-3, RADC TDR 62-224, vol. 1, April 1962, 190 p., incl. illus., tables, refs., AD 282 726.

. . . experimental program was also conducted to determine the feasibility of designing a continuously operable laser amplifier. . . . conclusion . . . is that laser communication systems can be developed which will permit realization of the inherently great communication potential of the optical frequency band. . . . supported by an analysis of ideal interplanetary and interstellar laser communication systems, and a discussion of the feasibility of developing the required laser oscillators and amplifiers. Detailed analyses are given of various arrangements for demonstrating the long-range communication potential of the laser by using a diffusely - reflecting earth satellite (such as Echo II) as a highly attenuating link between ground-based transmitting and receiving stations.

THE INTERPLANETARY AND INTERSTELLAR COMMUNICATION POTENTIAL OF THE LASER
D. S. Bayley, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 369/374.

THE INTERPLANETARY AND INTERSTELLAR COMMUNICATION POTENTIAL OF THE LASER
D. S. Bayley, General Precision Aerospace Technical News Bulletin, vol. 5, 4th Quarter, 1962, p. 12/17, A63-14773.

Analysis of an idealized laser communication system in order to demonstrate its long-range communication potentials. . . . it is concluded that the large communication potential of the optical frequency band will promote solution of the various problems involved in the alignment of the transmitter and receiver beamwidths and bandwidths. . . . The results presented apply to an experiment for demonstrating the long distance communication potential of a ruby laser by using a diffusely reflecting Earth satellite as a highly attenuating link between Earth-based transmitting and receiving stations.

OPTICAL MASER SYSTEMS FOR INTERPLANETARY COMMUNICATIONS
V. J. Corcoran, et al., Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 14/20, 18 refs.

The requirements for the use of optical masers for voice communications over interplanetary distances are calculated. . . . difficulties in realizing an actual optical space communication system are determined. The areas of research and development necessary to obtain a possible system are delineated. . . .

RECEPTION OF COHERENT WAVES IN RADIO-ELECTRIC AND OPTICAL FORMS (In French)
G. Pircher, Onde Electr., vol. 42, no. 429, Dec. 1962, p. 1063/1068.

. . . description of various basic differences between transmission of information on optical carriers and on radio-electric carriers . . . importance of lateral coherence in the optical form . . . comparison of the noise . . . effect of quantum fluctuations in optics . . . comparison of the powers necessary in radio electricity and in optics.

INVESTIGATION OF OPTICAL SPECTRAL REGIONS FOR SPACE COMMUNICATIONS
R. A. Rollin, Jr., Institute of Science and Tech., U. of Michigan, Ann Arbor, Interim rept. no. 1, 1 Feb.-30 April 1962, Rept. no. 4968-1-p, July 1962, 17 p., 5 refs., AD 278 215.

. . . problem of background interference and on communications systems components for the optical spectral region . . . The principle power loss in space communications is in beam divergence. The compilation of data on radiation from the sun, planets, and stars made it possible to categorize background interference . . . Coherent sources (lasers) can be modulated externally, but so far laser capabilities are far short of theoretical predictions. Photoconductive detectors have a higher sensitivity and a narrower spectral response than thermal detectors. (See also AD 287 640).

TOTAL SYSTEM ASPECTS OF OPTICAL VERSUS R-F SPACE COMMUNICATIONS
H. E. Weber, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 84/91.

. . . including associated subsystems and considering mission requirements, system weights, and overall link efficiencies. Hypothetical system designs are made considering presently available components and techniques as well as components which appear to be theoretically feasible.

MEASUREMENTS OF REFLECTING PROPERTIES OF VARIOUS AIRCRAFT COATINGS WHEN ILLUMINATED BY A LASER
S. E. Barber, et al., NAVWEPS rept. no. 80-84, Jan. 1963, 10 p., AD 297 746.

LIMITATIONS ON LASERS FOR DEEP SPACE COMMUNICATION
L. R. Bittman, IEEE Conference paper No. 63-57, Feb. 1963, 6 p.

The energy associated with extremely high frequency photons of laser communication systems decreases their efficiency in transferring a given rate of information as compared to conventional radio systems. . . . unless elaborate and costly precision tracking gear is used and the receiver position is known to high precision, extremely narrow beamwidths are forbidden . . . The 8- to 13-micron IR range is considered to be optimum for space communications.

INJECTION-LASER SYSTEMS FOR COMMUNICATIONS AND TRACKING
C. M. Johnson, Electronics, vol. 36, Dec. 13, 1963, p. 34/39, 16 refs., A64-11737.

. . . theoretical aspects of laser communications, available bandwidths, usable signals, the characteristics of a pulse system, available transmitter power, and efficiency. An experimental injection laser system is briefly described, as well as a hypothetical 5-Mc bandwidth link between a satellite and a ground station . . . As an example, the problem of one space vehicle tracking another at 50 miles is briefly examined.

ON DETERMINATION OF THE OPTICAL ABSORPTION COEFFICIENT
A. Kahan, et al., Air Force Cambridge Research Lab., Bedford, Mass., AFCRL 63 325, June 1963, 63 p., AD 415 441.

. . . in terms of the transmission and reflection coefficients T and R . . . a computer program is described for the calculation of the absorption coefficient and optical constants either from the combination of reflection and transmission coefficients or from transmission experiments on two samples of different thicknesses. . . .

POLARIZATION MODULATION AND DEMODULATION OF LIGHT
W. Niblack, et al., Appl. Optics, vol. 3, Feb. 1964, p. 277/279, A64-14262.

Description of an optical communication system employing polarization modulation-demodulation. The system offers significant improvements in usable transmitted power or extended range, lessened susceptibility to interference from linearly polarized background light, and ease of transmitter/receiver alignment over the performance of a comparable intensity-modulated optical communication system.

INVESTIGATION OF OPTICAL SPECTRAL REGIONS FOR SPACE COMMUNICATIONS
R. A. Rollin, Jr., Institute of Science and Tech., U. of Michigan, Ann Arbor, Final rept., Feb. 1962-Jan. 1963, ASD TDR63 185, May 1963, 253 p., AD 410 537.

. . . derivation of the range equation was refined. The performance of seven systems were compared. Coherent laser sources were found to be superior to conventional sources. A literature search on transmitter and receiver components . . . Background interference was investigated. The solar noise experiment is reported and described.

OPTICAL PROPERTIES OF LASERS AS COMPARED TO CONVENTIONAL RADIATORS
Spectra-Physics Laser Technical Bulletin, no. 1, June 1963, 10 p., A64-14089.

Comparison of the properties of coherent laser radiation with those of conventional incoherent radiation in a variety of optical applications. . . . When used in coherent optical data processing systems, the laser provides an increase in optical power relative to the incoherent source in the range 2 to 4 orders of magnitude for one-dimensional data processing, and in the range 5 to 9 orders of magnitude for two-dimensional data processing . . . It is shown that, in a large number of applications, the use of a laser will yield an increase of many orders of magnitude in useful intensity relative to that obtainable from an incoherent radiator.

Related Publications:

STUDY OF LASER OUTPUT PARAMETERS AND MEASUREMENT TECHNIQUES
E. R. Schineller, et al., Wheeler Labs., Inc., Great Neck, N. Y., Final rept., 20 May-20 Nov. 1963, Rept. no. 1182, RADC TDR 63 564, Feb. 1964, 163 p., AD 433 174.

3B.411: Theoretical Analysis of Light Communications Systems

Included: Range equation in optical communications; Anaylsis of special modulation methods in optical communications; Information capacity of optical links; Narrow beam acquisition problems; Intermodulation distortion.

Not Included: Modulation methods in general (1).

Cross References: Optical modulators (3B.350).

Principal Publications:

OPTICAL SYSTEMS AS COMMUNICATION CHANNELS
P. Elias, Proc. Symp. Inf. Netw., vol. 3, April 1954, p. 321/328.

INFORMATION CAPACITY OF CHANNELS USING INTENSITY MODULATION OF LIGHT OR X-RAYS
D. E. Savage, Rome Air Development Center, Griffiss Air Force Base, N. Y., Rept. no. RADC TN 60-209, Dec. 1960, 29 p., incl. illus., AD 249 754.

INVESTIGATION OF OPTICAL SPECTRAL REGIONS FOR SPACE COMMUNICATIONS
R. A. Rollin, Jr., Institute of Science and Tech., U. of Michigan, Ann Arbor, Interim rept. no. 2, 1 May-31 July 1962, Rept. no. 4968-2-P, Nov. 1962, 188 p., incl. illus., tables, 65 refs., AD 287 640.

. . . derivation of the general optical systems range equation and equations for the maximum theoretical range of optical communications and the maximum theoretical channel capacity . . .

RECEPTION OF SINGLE-SIDEBAND SUPPRESSED-CARRIER SIGNALS BY OPTICAL MIXING (Correspondence)
L. R. Bloom, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 610/611.

. . . a . . . receiving apparatus in which sideband signals can be demodulated by optically mixing them with a reinserted carrier in a photodetector. . . .

DESIGN OF A LASER DEEP SPACE COMMUNICATION SYSTEM
K. L. Brinkman, et al., Rec. Nat. Space Electronics Symp., no. 7.1, 1963.

. . . utilizing a laser transmitter and an optical receiver. . . . designed for two-way transmission of information over interplanetary distances for a 1965-70 time period. Abstract Only . . .

STUDY ON OPTICAL COMMUNICATIONS FROM DEEP SPACE
K. L. Brinkman, Hughes Aircraft Col. Culver City, Calif., Aerospace Group, Interim Progress Report, 27 March-31 May 1963, 1963, 77 p., refs., N64-16770.

A system-design analysis is performed for the deep-space vehicle-to-earth link, using simple quantum detection. The effects of atmospheric turbulence on the selection of system-design parameters are discussed as are the considerations concerning site selection in order to avoid the problem of interfering weather and cloud cover. Two different systems were chosen for analysis-a pulsed laser using PPM, and a continuous-wave laser using PCM with polarization modulation. A comparison between the two systems shows a strong bias toward PPM systems in a low-noise environment; as the noise increases the PCM system very likely takes precedence. Thus, the system noise plays a significant role in the optimum-system selection.

OPTICAL COMMUNICATIONS EMPLOYING INFRARED EMITTING DIODES AND FM TECHNIQUES (Correspondence)
E. J. Chatterton, Proc. IEEE, vol. 51, no. 4, April 1963, p. 612.

ON THE NARROW BEAM COMMUNICATION SYSTEM ACQUISITION PROBLEM
J. S. Greenberg, IEEE Trans. Mil. Electronics, vol. MIL-8, no. 1, Jan. 1964, p. 28/39.

It is desired to establish a communication link between two separated transmit-receiver terminals, each having narrow beamwidths and specified uncertainty as to relative angular locations. To achieve the communication link the narrow beams must point directly at each other. The purpose of this paper is to determine the search or acquisition time required by the two terminals to achieve the desired state of knowledge whereby the transmit-receive beams of both terminals are pointed in the required directions, signals are mutually recognized and the communication link is thereby established. . . .

INFORMATION CAPACITY AND QUANTUM EFFECTS IN PROPAGATION CIRCUITS
T. Hagfors, Lincoln Lab., Mass. Inst. of Tech., Lexington, ESD TDR 64 23, 24 Jan. 1964, 41 p., AD 436 639.

. . . to establish an upper bound on the information capacity of an electromagnetic wave propagation circuit between two apertures when quantum effects come into play. . . . evaluating the channel capacity under average and peak power constraints. Due to mathematical difficulties we are only able to establish the channel capacity explicitly when the radiative losses become extreme. . . .

SOME QUANTUM CONSIDERATIONS FOR SUB-MILLIMETER AND OPTICAL COMMUNICATIONS

D. P. Harris, et al., Lockheed Aircraft Corp., Sunnyvale, Calif., Technical rept., Rept. no. 6-90-63-19, Jan. 1963, 25 p., incl illus., 11 refs., AD 401 845.

Error probabilities and bounds on information transmission capacities . . . for some communications techniques applicable to channels with significant quantum disturbances. . . . performance of systems using ideal energy detection with and without signal preamplification. The consequences of using signals of limited coherence are evaluated in several cases. Where additive noise is negligible, it has been found that performance of systems using elementary pulse-position (and frequency-shift) modulation schemes and photon-counting detectors can be made insensitive to imperfections in signal coherence.

A COMPARISON OF RADIO AND OPTICAL COMMUNICATIONS

J. F. Honey, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 331/341, 15 refs.

. . . a brief introduction to optical communication problems in terms familiar to the radio communications engineer. . . . photon or radiation noise environment at IR, visible and higher frequencies, . . . desirability of wideband modulation techniques. Communication range equations . . .

OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY VOLUME I: SUMMARY, CONCLUSIONS, RECOMMENDATIONS

S. R. Hurst, et al., General Electric Co., Philadelphia, Pa., Valley Forge Space Technology Center, Final Report, March 1964, 36 p., refs., N64-19990.

. . . Performance of a preliminary analysis of three assigned missions, with the object of identifying the salient advantages and problem areas of optical communication . . . theoretical information capacity of a noisy quantized wave . . . theoretical performances of the major types of receivers (heterodyne, homodyne, and quantum counter) . . . Propagation in the atmosphere . . . low-level photodetection . . . applied to the following missions of interest, and the performances are calculated: Mars-Earth terminal, Mars-Earth satellite, Moon base-Earth terminal . . .

COMMUNICATION USING FREQUENCY-MODULATED LIGHT

J. V. Ramsay, et al, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 9, Sept. 1963, p. 673/677.

. . . It is of interest . . . to investigate the relative merits of frequency and amplitude modulation for communication with the very high "carrier" frequencies (of the order of 10^{14} c/s) of light. . . . we show how to construct tunable Fabry-Perot interferometers with high mechanical resonant frequencies, and how they can be used in a 0-3 kc/s communication channel. The system consists essentially of a sender (a tunable interferometer), and a receiver (another tunable interferometer servo-controlled to follow the frequency transmittance of the sender). Communication has been achieved over a distance of 1.6 km; comparative tests have shown the superiority of the frequency-modulated over the amplitude-modulated system. . . .

NONCONVENTIONAL COMMUNICATION DEVICES FOR THE MARS MISSION?

K. M. Siegel, et al., In: Exploration of Mars; Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963, (Advances in the Astronautical Sciences, Vol. 15), North Hollywood, Western Periodicals Co., 1963, p. 389/395, A64-10117.

. . . advantages . . . of. . . systems operating at wavelengths other than microwave - e.g., optical and millimeter, are weighed against the disadvantages. It is concluded that some small relative advantage can probably be gained in the millimeter range. No foreseeable advantage exists in the optical range. Therefore, it appears that improvements in space communication techniques are most likely to be found within the microwave region.

INTERMODULATION DISTORTION IN GaAs INFRARED EMITTERS (Correspondence)

L. M. Vallese, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1252.

Recently Pankove and Berkeyheiser have described experiments of the modulation of GaAs infrared emitters. . . . aroused great interest in their utilization for communication links. For such applications, the study of the linearity of modulation is of basic importance. Distortion may be produced by nonlinearities associated with the input current-voltage characteristic and with the mechanism of photon emission. . . .

<u>Related Publications:</u>

OPTICAL DOPPLER MEASUREMENTS FOR SPACE NAVIGATION

JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 29/31.

OPTICAL DOPPLER MEASUREMENTS FOR SPACE NAVIGATION
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 11/14.

SINGLE-SIDEBAND SUPPRESSED-CARRIER MODULATION OF COHERENT LIGHT BEAMS (Correspondence)
C. F. Buhrer, et al., Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1827/1828.

. . . with a coherent carrier obtained from a helium-nenon gas laser . . .

SINGLE-SIDEBAND MODULATION AND RECEPTION OF LIGHT AT VHF (Correspondence)
C. F. Buhrer, et al., Proc. IRE, vol. 50, no. 12, Dec. 1962, p. 2492.

. . . an extension of the phasing method of SSB modulation to optical frequencies. . . . we present a VHF version of this light modulator and then describe an optical analog of the phasing method of SSB reception. . . .

INFORMATION TRANSMISSION RATE AT VERY LOW SIGNAL AND NOISE POWER
P. Leliak, et al., IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 407/415.

. . . calculations are made using the assumption that the signal energy received is a Poisson-distributed random variable. . . . for communication from earth to a very deep space . . . near-space (earth satellite) relay . . . transmission from the relay to outer space. This paper considers the latter link . . . A short burst of electromagnetic energy contains a number of discrete packets (photons) . . . the number of photons actually received during a given burst is a random variable, Poisson distributed . . .

SPACE COMMUNICATIONS BY THE USE OF LASERS: AN ENUMERATIVE BIBLIOGRAPHY
P. L. Simmons, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 449/456.

. . . traces the history of lasers in relation to communication and other applications from their inception to early 1962. Documentation includes books and periodicals including foreign language research. 379 references.

HARMONIC STRUCTURE OF MODULATED LIGHT BEAMS
J. E. Hopson, IEEE Trans. Commun. Syst., vol. CS-11, no. 4, Dec. 1963, p. 464/469, 15 refs.

. . . modulation of light by means of electro-optic modulators and the detection and analysis of the modulation by means of photocell detectors. . . . anisotropic materials used to create the modulation effects. . . . harmonic structure for a variety of electro-optic modulators. Comparisons . . .between the frequency and power responses of the various modulators.

BALANCED OPTICAL DISCRIMINATOR
I. P. Kaminow, Appl. Optics, vol. 3, April 1964, p. 507/510, 7 refs., A64-16297.

. . . An angle-modulated system at optical frequencies, employing a balanced discriminator, has advantages over intensity-modulated systems, which are more commonly used at radio frequencies. . . .

LASERS FOR COMMUNICATIONS AND OPTICAL RANGING
G. F. Smith, Hughes Research Labs., Malibu, Calif., In AGARD, Paris, Light and Heat Sensing, 1963, p. 221/234, refs., N64-15469.

. . . In a one-way communications link with constant-aperture diffraction-limited antennas, the fraction of transmitted power that is received is proportional to the square of the frequency. Signal fluctuation noise, however, increases linearly with frequency. At optical frequencies, aiming problems are likely to limit the useful degree of beam collimation; thus, on the basis of bandwidth per transmitted watt, a laser space-communications link will be competitive with, but drastically superior to, a futuristic microwave space link. The high-power pulse performance of ruby lasers is promising for optical ranging . . .

3B.412: Propagation of Optical Communications Signals

Included: Plasma light scattering effects; Far field radiation pattern of laser radiation; Propagation characteristics of incoherent light; Over the horizon transmission of light signals; Effect of atmosphere on coherent light beams; Atmospheric attenuation of light beams; Sparkling spots in laser beams; Random diffraction of coherent light; Polarization induced by strong laser beams; Optical transmission through heated air; Laser sparkle patterns; Atmospheric windows; Infrared propagation characteristics; Light beam waveguides; Long distance light transmissions; Optical Faraday rotation.

Not Included: Electromagnetic wave theory; Geophysics; Astrophysics.

Cross References: Propagation of quasi-optical waves (3B.210).

Principal Publications:

RESEARCH ON ATMOSPHERIC ATTENUATION OF INFRARED RADIATION
H. T. Betz, Labs. for Applied Sciences, U. of Chicago, Ill., Quarterly rept. no. 1, 1 July-30 Sept. 1959, Rept. no. LAS-QR-E-173-2, Sept. 1959, 23 p., AD 401 361.

RESEARCH ON ATMOSPHERIC ATTENUATION OF INFRARED RADIATION
L. M. Biberman, Chicago Midway Labs., U. of Chicago, Ill., Progress rept. no. 1, Rept. no. CML-L-E173-1, 30 June 1959, 18 p., incl. illus., tables, AD 401 362.

EFFECT OF NIGHT SKY BACKGROUNDS ON OPTICAL MEASUREMENTS
R. M. Chapman, et al., Geophysics Corp. of America, Bedford, Mass., Final rept., 6 March 1959, 59 p., AD 417 753, AD 412 678.

A review is given of the sources and magnitudes of the night sky backgrounds from 0.3 to 5 microns, particularly as they might interfere with the observation of the spectrum of a small missile re-entering the atmosphere. . . .

ROTATIONAL SPECTRUM OF WATER VAPOR AND THE ABSORPTION OF HUMID AIR IN THE 40-2500 MICRON WAVE LENGTH REGION
N. G. Iaroslavskii, et al., Optics and Spectrosc., vol. 6, June 1959, p. 521/522.

SATELLITE OBSERVATIONS OF INFRARED RADIATION
R. Wexler, Allied Research Associates, Inc., Boston, Mass., Semi annual technical summary rept. no. 1, 24 Dec. 1959, 29 p., AD 418 541.

USE OF OPTICAL FREQUENCIES FOR SPACE COMMUNICATION
C. B. Ellis, IRE Trans. Commun. Syst., vol. CS-8, no. 3, Sept. 1960, p. 164/168.

The spectrum from the infrared through the visible to gamma rays has been surveyed for signalling from Earth or an Earth satellite to a spaceship at planetary distances. The best region for signalling from a satellite vehicle appears to be from 2000 to 400 angstroms.

PROPAGATION STUDIES AT RADIO AND OPTICAL FREQUENCIES
R. E. Anderson, Nat. Commun. Symp. Rec., vol. 7, Oct. 1961.

There are several relatively narrow frequency bands in the electro-magnetic radiation spectrum that penetrate through the earth's atmosphere into space. These "windows" are shown. . . lie between 30 and 10,000 megacycles for radio transmission, and from infrared light through visible and into ultraviolet for optical communications. . .

EFFECTS OF ATMOSPHERIC TURBULENCE ON OPTICAL INSTRUMENTATION
R. A. Becker, IRE Trans. Mil. Electronics, vol. MIL-5, no. 4, Oct. 1961, p. 352/356.

ATMOSPHERIC ABSORPTION OF 10-400 kMcps RADIATION: SUMMARY AND BIBLIOGRAPHY TO 1961
E. S. Rosenblum, Microwave J., vol. 4, no. 3, March 1961, p. 91/96.

A SPACE BACKGROUND STUDY
P. Barnhart, et al., Eastman Kodak Co., Rochester, N. Y. Semi-Annual rept., 1 Jan.-1July 1962, Rept. no. EK/ARD ED-874, 31 July 1962, 31 p., incl. illus., AD 281 724.

. . . to characterize the space background in the infrared spectral region. Many possible causes for previous measurement errors are discussed. . . .

CORRECTION TO "EFFECTS OF ATMOSPHERIC TURBULENCE ON OPTICAL INSTRUMENTATION"
R. A. Becker, IRE Trans. Mil. Electronics, vol. MIL-6, Jan. 1962, p. 40/41.

RESEARCH ON ATMOSPHERIC ATTENUATION OF INFRARED RADIATION
H. T. Betz, et al., Laboratories for Applied Sciences, U. of Chicago, Ill., Final rept., Rept. no. LAS-TR-173-15, AFCRL 62-480, April 1962, 70 p., incl. illus., tables, AD 276 625.

MEASUREMENT OF ATMOSPHERIC ATTENUATION ABOARD USAS AMERICAN MARINER

H. R. Byck, Barnes Engineering Co., Stamford, Conn., Progress rept. on Infra-Red and Electro-Optics, 12 March 1962, 20 p., incl. illus., AD 273 612.

. . . analysis of optical measurements obtained on reentry studies. . . The problem of atmospheric effects on the observation of a reentry event entails a knowledge of the transmission of the entire atmosphere at different elevation angles. . .

SPECTRAL REFLECTIVITY OF THE EARTH'S ATMOSPHERE III: THE SCATTERING OF LIGHT BY ATOMIC SYSTEMS

A. Dalgarno, Geophysics Corp. of America, Bedford, Mass., GCA technical rept. no. 62-28-A, Dec. 1962, 37 p., incl. illus., tables, 9 refs., AD 279 883.

IONIZATION OF GASES BY OPTICAL MASER RADIATION

E. K. Damon, et al., Ohio State U., Research Foundation, Antenna Lab., Columbus, Rept. 1083-19, Nov. 30, 1962, 9 p., refs., N63-18288.

Apparent ionization of noble and atmospheric gases in a focused laser beam has been observed. The effect shows a strong nonlinearity and appears to be power dependent rather than energy dependent. The results of preliminary measurements using conventional and Q-switched laser pulses are included.

INFRARED TRANSMISSION THROUGH THE ATMOSPHERE

A. E. Green, et al., General Dynamics Astronautics, San Diego, Calif., 25 May 1962, 10 p., AD 432 743.

Reprint from Applied Optics 2, p. 561/570, June 1963.

An analytic expression for transmission in terms of optical path and pressure is combined with an analytical expression for equivalent atmospheric path length in terms of height and slant angle to yield a single expression for transmission terms of height and slant angle. Separate equations are developed for carbon dioxide absorption, and for water vapor absorption. . . .

AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR

M. N. Hirsh, et al., Dewey, G. C., and Co., Inc., New York, Quarterly progress rept. no. 5, 1 July-30 Sept. 1962, Rept. no. R-146-5, 30 Sept. 1962, 30 p., incl. illus., tables, refs., AD 291 507.

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A. C. Holland, et al., Geophysics Corp. of America, Bedford, Mass., GCA technical rept. no. 62-27-A, Dec. 1962, 97 p., incl. illus., tables, 31 refs., AD 297 884.

TRANSMISSION OF THE ATMOSPHERE IN THE INFRARED. A REVIEW

J. N. Howard, et al., Air Force Cambridge Research Labs., Bedford, Mass., Rept. no. AFCRL 62-814, Air Force Surveys in Geophysics no. 150, July 1962, 24 p., incl. illus., tables, refs., AD 289 530.

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WATER VAPOR ABSORPTION STUDIES WITH A HELIUM-NEON OPTICAL MASER

R. K. Long, et al., Antenna Lab., Ohio State U. Research Foundation, Columbus, Report on Study of Electromagnetic Radiation, Rept. no. 1083-20, 30 Nov. 1962, 18 p., incl. illus., 8 refs., AD 292 166.

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RESEARCH CONCERNING INFRARED EMISSIVITY (I)

ATMOSPHERIC OPTICAL NOISE MEASUREMENTS (II)

R. Paulson, et al., Syracuse U., N. Y., Final rept., AFCRL 62-869, 15 Aug. 1962, 131 p., incl. illus., refs., AD 287 517.

In an effort to determine the limits of detectability and discrimination of ground objects, investigations were conducted concerning the effective emissivities of various terrain objects. . . .

INFRARED TRANSMISSION STUDIES. VOLUME I. SPECTRAL BAND ABSORPTANCE FOR ATMOSPHERIC SLANT PATHS

G. N. Plass, Aeronutronic, Newport Beach, Calif., SSD TDR62 129, vol. 1, 2 Aug. 1962, 42 p., AD 436 839.

BIREFRINGENCE CORRECTION FACTORS FOR THE SCATTERING OF LIGHT BY AN ANISOTROPIC SAMPLE

R. S. Stein, et al., Polymer Research Inst., U. of Mass., Amherst, Technical rept. no. 47, 5 July 1962, 36 p., AD 430 431.

NON-COHERENT SCATTERING IN A SEMI-INFINITE INHOMOGENEOUS ATMOSPHERE
A. Uesugi, Kyoto U. Inst. of Astrophysics (Japan), Kyoto U. Inst. of Astrophys. and Kwasan Obs., Contrib. no. 110, 1962, 8 p., 11 refs., N63-16195.

. . . The diffusely reflected light from a nonemitting atmosphere is expressed in terms of the scattering function when the surface is subject to known incident radiation.

NON-COHERENT SCATTERING FOR BLENDED LINES
A. Uesugi, Kyoto U. Inst. of Astrophysics (Japan), Kyoto U. Inst. of Astrophys. and Kwasan Obs., Contrib. no. 112, 1962, 7 p., 15 refs., N63-16196.

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. . . calculated over a wide range of path length, pressure, and temperature from 1000 to 10,000 reciprocal cm. The results are presented in extensive tables. . .

EMISSION OF RADIO WAVES UPON MODULATION OF AN INTENSE BEAM OF LIGHT IN A MEDIUM (Translation)
G. A. Askar'ian, Soviet Physics - JETP, vol. 18, Feb. 1964, p. 441/443, A64-16102.

Theoretical study of the emission of radio waves from an intense modulated beam of light passing through a medium. The emission is caused by the change of the mean nonlinear polarization of the medium when the beam intensity or polarization is varied. . . .

MODULATION OF SQUARE-WAVE OBJECTS IN INCOHERENT LIGHT. I.
R. Barakat, et al., J. Opt. Soc. Amer., vol. 53, Dec. 1963, p. 1371/1376, A64-11617.

Study of the effect of diffraction on imaging a square-wave object. . . in incoherent light for slit and circular apertures suffering from spherical aberration. A modification of the usual Fourier series representation of the square wave is required to eliminate the unwanted Gibbs phenomena. . . .

SOME SHORT-RANGE NARROW-BEAM ATMOSPHERIC TRANSMISSION MEASUREMENTS IN THE NEAR INFRA-RED
G. E. Berlinguette, et al., Defence Research Chemical Labs. (Canada), DRCL 420, Dec. 1963, 20 p., AD 434 456.

Horizontal atmospheric transmission has been measured for the wavelength region 0.9 micron to 5.9 micron with path lengths of 7m, 10 m, 0.27 km, 0.67 km and 1.1 km. Water vapour contents of the paths varied from 0.02 to 7.4 mm of precipitable water. . . .

SYMPOSIUM ON BACKGROUND RADIATION. ULTRAVIOLET, VISIBLE AND INFRARED LEVELS AND DISTRIBUTIONS (SPRING 1962)
L. M. Biberman, et al., Chicago U. Labs. for Applied Sciences, Ill., April 1963, 122 p., 37 refs., N63-18473.

INVESTIGATION OF THE INFRARED EMISSION SPECTRUM OF THE ATMOSPHERE AND EARTH
H. Bolle, et al., Munich U., (Germany), Technical rept. no. 2, AFCRL 63 680, May 1963, 191 p., AD 416 497.

. . . The separation of line and continuum emission in the 8-26 micron sky emission spectrum and its calculation by means of radiation diagrams is discussed for narrow spectral intervals containing no, one, or two water vapor rotational lines. . . A radiation diagram for the 8.75 - 12.25 micron window region is presented. . .

INTERACTION OF INTENSE LASER BEAMS WITH ELECTRONS
L. S. Brown, et al., Phys. Rev., 2nd Series, vol. 133, Feb. 3, 1964, p. A705/A719, 18 refs., A64-14809.

Discussion of the interaction of an intense coherent photon beam with free electrons, treating the photon beam as a classical external electromagnetic field. The analysis is exact within the approximation of neglecting radiative corrections. . . .

THE CALCULATIONS OF SPECTRAL ABSORPTION IN HEATED AIR
D. R. Churchill, et al., Lockheed Aircraft Corp., Sunnyvale, Calif., Rept. no. TR3 27 63 4, Dec. 1963, 153 p., AD 436 885.

. . . Digital computer programs. . . were used to compute optical transmissions through heated air. . . .

TRANSMISSION OF LIGHT SIGNALS OVER THE HORIZON
J. A. Curcio, Naval Research Lab., Washington, D. C., In its Rept. of NRL Progr., Dec. 1963, p. 8/15, N64-19178.

. . . Experimental data are presented that show the signal strength of near-infrared light (7,400 to 10,000 A) as a function of distance out to 90 km. Some recent daytime experiments over a 45-km path indicate that a light source of about 1-mw peak power would be needed for a system to work in daytime when the meteorological range is as low as 9km.

TRANSMISSION OF RUBY LASER LIGHT THROUGH WATER
J. A. Curcio, et al., Naval Research Lab., Washington, D. C., NRL Rept. no. 5941, 18 June 1963, 11 p., AD 412 313.

RESEARCH ON ATMOSPHERIC OPTICAL RADIATION TRANSMISSION
E. de Bary, et al., Johannes Gutenberg-Universitat (Germany), 31 Jan. 1964, 124 p., AFCRL 64 126, AD 434 773.

LONG-DISTANCE LIGHT PROPAGATION (Correspondence)
O. E. De Lange, Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1361.

. . . experiment. . . performed to determine the magnitude of the losses encountered in the long-distance transmission of an enclosed beam of light. For such transmissions it is necessary to redirect the beam at intervals in order to follow the terrain. The directors might consist of lenses, mirrors or prisms. For this experiment, spherical mirrors were chosen and the path folded back on itself so that the beam repeatedly traversed the same path rather than following a different path each time it was redirected. . . . The total power lost, per round trip through the pipe, was found to be 2 per cent. Various experiments indicate that this loss is almost entirely mirror loss . . . This experiment is being continued and will be described in greater detail at a later date.

HIGH ALTITUDE INFRARED BACKGROUND EVALUATION
H. G. Eldering, Baird Atomic, Inc., Cambridge, Mass., Semi-annual technical documentary rept., SSD TDR63 147, 15 July 1963, lv., AD 417 135.

Infrared background radiance measurements obtained from a U-2 platform were digitalized and are being prepared for analysis. The final measurement data form will allow easy access by use of an IBM 7090 computer or devices which can read IBM binary tapes. Data analysis programs are being written and checked out. . . .

A MODEL OF A CLEAR STANDARD ATMOSPHERE FOR ATTENUATION IN THE VISIBLE REGION AND INFRARED WINDOWS
L. Elterman, Air Force Cambridge Research Labs., Bedford, Mass., Research rept., AFCRL 63 675, July 1963, 28 p., AD 422 014.

OPTICAL FARADAY ROTATION IN THE ATMOSPHERE
J. Finkel, J. Atmos. Terres. Phys., vol. 26, Feb. 1964, p. 297/299, 15 refs., A64-16138.

. . . in the near infrared, visible, and near ultraviolet spectra in the Earth's atmosphere. Account is taken of the variation of concentration and temperature with altitude. It is shown that the rotation takes place primarily in the first 130,000 feet above the Earth.

SCATTERING OF RUBY LASER LIGHT BY GASES
T. V. George, et al., Illinois U., Engineering Experiment Station, Urbana, Final Rept., AFCRL 63 549, Oct. 1963, 93 p., AD 427 730.

STATISTICAL PROPERTIES OF LASER SPARKLE PATTERNS
J. W. Godman, Stanford Electronics Labs., Stanford Univ., Calif., Rept. nos. TR2303 1, 63 140, Dec. 1963, 46 p., AD 436 736.

When laser light strikes a diffuse object, such as paper, the scattered light has been observed to possess a granular spatial structure. The statistical properties of these so-called "sparkle patterns," as seen by an observer in the far field of the scattering spot, are investigated. . . .

SOME ASPECTS OF BEAM WAVEGUIDES FOR LONG DISTANCE TRANSMISSION AT OPTICAL FREQUENCIES
G. Goubau, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-12, March 1964, p. 212/220, 14 refs., A64-17235.

Discussion of iris-type and lens-type guides. Both appear applicable to guided long distance transmission of light with theoretical losses of less than 1 db/Km. An experimental lens-type waveguide was constructed, 970 m in length comprising 10 iterations. The light path was enclosed by a 4-inch aluminum pipe which was supported within a 6-inch aluminum pipe. No serious optical alignment problems were encountered. . .

ATMOSPHERIC TRANSMITTANCE CURVES FOR SEVERAL METEOROLOGICAL CONDITIONS
M. W. Harper, Army Missile Command, Redstone Arsenal, Huntsville, Ala., AMC RE TR63 13, 25 March 1963, 49 p., AD 420 700.

. . . intended to provide a tool for use in designing infrared systems, and is not a theoretical treatise on atmospheric effects in optical transmission. . . .

TRANSMISSION OF COHERENT LIGHT THROUGH SHOCK PRODUCED PLASMAS (Correspondence)
D. A. Hayler, et al., Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 365.

AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR
M. N. Hirsh, et al., Dewey, G. C., and Co., Inc., New York, Quarterly progress rept. no. 7, 1 Jan.-31 March 1963, Rept. no. R146 7, 35 p., AD 415 742.

. . . measurement of time-dependent ionization phenomena. . . A detailed calculation of the role of diffusion in transient ionization phenomena has been started. . .

ON THE SPECTRUM OF OPTICAL WAVES PROPAGATED THROUGH THE ATMOSPHERE (B. S. T. J. Briefs)
D. C. Hogg, Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2967/2969.

. . . the power received at some distance from an optical source fluctuates randomly and possesses a characteristic low-frequency power spectrum.

The purpose of this note is to discuss typical low-frequency spectra resulting from propagation of 0.63-micron radiation over a 2.6-km path. A vertically polarized helium-neon maser of power output 10 mw and a reflecting telescope of 9-cm diameter comprise the source. . . The receiver is a refracting telescope of 5-cm diameter with associated filters, polarizers, and attenuators which feed a photomultiplier . . . the output of the photomultiplier is taken to a wave analyzer whose bandwidth is 4 cps.

FAR-FIELD RADIATION PATTERN
G. J. Lasher, et al., International Business Machines Corp., Yorktown Heights, N. Y., Thomas J. Watson Research Center, In its Injection Laser Study (1963), p. 29/32, N64-17872.

Numerical calculations are being conducted to determine the angular distribution of the far-field radiation pattern of an idealized three-region model of a laser. The active region and the two surrounding regions of the crystal are assumed to have constant, but usually differing, indices of refraction and absorption coefficients. From this model it will be possible to have a fairly complete description of the wave inside the crystal, its gain, and the far-field pattern. . .

ABSORPTION OF LASER RADIATION IN THE ATMOSPHERE
R. K. Long, Ohio State U. Research Foundation, Columbus Antenna Lab., Rept. 1579-3, May 31, 1963, 167 p., 64 refs., N63-19987, AD 410 571.

Laser sources have been proposed for communications and radar applications in the atmosphere; therefore, a knowledge of the loss parameters of the atmosphere at the laser frequencies is needed for the design of these systems. . . . a study of one of these loss parameters, molecular resonance absorption, over the 0.6- to 20.0-micron wavelength region. The absorption at more than one hundred laser frequencies was determined. . . .

ATMOSPHERIC ATTENUATION OF RUBY LASERS (Correspondence)
R. K. Long, Proc. IEEE, vol. 51, no. 5, May 1963, p. 859/860.

. . . for either radar or communications . . . A number of propagation problems are potentially troublesome, including molecular and aerosol scattering, turbulence, and molecular absorption. The purpose of this communication is to discuss the molecular absorption problem as it relates to ruby lasers.

OPTICAL FREQUENCY ELECTRICAL DISCHARGES IN GASES
R. W. Minck, J. Appl. Phys., vol. 35, Jan. 1964, p. 252/254, A64-14057.

INFRARED ATMOSPHERIC TRANSMITTANCE AND FLUX MEASUREMENTS
D. G. Murcray, Denver U., Colo. Semi-annual technical rept. no. 6, 1 Jan.-30 June 1963, 8 July 1963, 15 p., AD 416 813, AD 419 769.

. . . attenuation of infrared radiation in traversing a slant path in the atmosphere, and the absolute intensity and spectral distribution of the upward and downward flux of infrared radiation at various altitudes above the earth's surface. . .

SPARKLING SPOTS AND RANDOM DIFFRACTION (Correspondence)
B. M. Oliver, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 220/221.

The visible CW laser has revealed an unforeseen phenomenon. When the beam illuminates a fixed diffuse reflecting surface such as a matte white screen, the illuminated area has a sparkling appearance. . . .

INFRARED TRANSMISSION STUDIES. VOLUME IV: THE INFLUENCE OF NUMEROUS WEAK LINES ON THE ABSORPTANCE OF A SPECTRAL BAND
G. N. Plass, Aeronutronic, Newport Beach, Calif., Final Report, SSD-TDR-62-127, Vol. IV, April 12, 1963, 27 p., N63-16595.

INFRARED TRANSMISSION STUDIES. VOLUME VI: MIE SCATTERING AND ABSORPTION CROSS SECTIONS OF ALUMINUM OXIDE AND MAGNESIUM OXIDE
G. N. Plass, Aeronutronic, Newport Beach, Calif., Final Rept., SSD-TDR-62-127, Vol. VI, 27 May 1963, 18 p., 9 refs., N63-18839.

The complex index of refraction was taken from the best available experimental data. Tables of the effeciency factors for scattering, absorption, and extinction are given for particle radii from 0.1 μ to 5.1 μ and a range of wavelengths from 0.5 μ to 10 μ.

NEAR INFRARED BACKGROUND CLUTTER AND ATMOSPHERIC TRANSMISSION
E. C. Reifenstein, III, et al., Little, Arthur D., Inc., Cambridge, Mass., Semiannual rept., SSD TDR63 146, May 1963, 9 p., AD 407 251.

. . . to obtain infrared background data from a U-2 aircraft that will assist in the design and evaluation of future space-based infrared detection systems.

POLARIZATION INDUCED IN A DIELECTRIC MEDIUM BY AN INTENSE LASER BEAM
J. E. Rosenthal, et al., Proc. IEEE, vol. 51, no. 7, July 1963, p. 1031/1032.

. . . deals with two types of effects expected on the basis of classical electromagnetic theory when an intense coherent light beam (peak power >50megw) is focused into an area $\sim(10\lambda)^2$ inside a transparent medium. The Effect of Intense Radiation on the Dielectric Constant of a Transparent Medium. . . The Processes Resulting from the Variation of the Dielectric Constant of the Medium with the Energy Density of the Electromagnetic Field. . .

SCATTERING OF OPTICAL PULSES FROM A NONEQUILIBRIUM PLASMA (Correspondence)
S. E. Schwarz, Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1362.

Fiocco and Thompson have reported observation of visible light scattered from an electron beam and also of light scattered from a continuous hollow-cathode discharge. . . . shows promise as a tool for plasma diagnostics. . .

INVESTIGATION OF COHERENT OPTICAL PROPAGATION
T. J. Skinner, Technical Operations, Inc., Burlington, Mass., Griffiss AFB, N. Y., Advanced Develop. Lab., Technical Documentary Report, RADC TDR-63-217, Nov. 1963, 107 p., refs., AD 424 928, N64-13426.

INFRARED TRANSMISSION STUDIES. VOLUME III. THE INFRARED ABSORPTION OF CARBON DIOXIDE
V. R. Stull, et al., Aeronutronic, Newport Beach, Calif., Final rept., SSD-TDR-62-127, 31 Jan. 1963, lv., incl. illus., tables, AD 400 959.

. . . has been calculated over a wide range of path length, pressure, and temperature . . . The results are presented in extensive tables. . .

WAVEFORMS FOR TRANSMISSION OF POLARIZED LIGHT THROUGH A CONSTANT AND A TIME VARYING PAIR OF BIREFRINGENT PLATES
G. B. Thurston, Oklahoma State, Research Foundation, Stillwater, Interim technical rept. no. 5, May 1963, 11 p., AD 410 374.

REFRACTION EFFECTS IN OPTICAL SPACECRAFT TRACKING
E. J. Tschupp, Space/Aeronautics, vol. 39, May 1963, p. 123/126, A63-18837.

. . . on satelliteborne IR systems used for search, acquisition, and long-range optical tracking. . .

A FAR INFRARED PROPOSAL
W. H. Wells, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 121/124.

. . . possibility of several atmospheric absorption windows in the far IR, provided one transmits only through dry atmosphere above a mountain peak. . . .

ABSORPTION OF ELECTROMAGNETIC RADIATION BY WATER VAPOR ON 10 - 2 CM WAVES IN THE UPPER LAYERS OF THE ATMOSPHERE (Translation)
S. A. Zhevakin, et al., Geomagnetism and Aeronomy, vol. 3, no. 4, p. 537/546, 27 refs., A64-17033.

Discussion of the dependence of the coefficient of absorption by water vapor on height above sea level with respect to electromagnetic waves in the centimeter, millimeter and submillimeter ranges. . .

ULTRAVIOLET VISIBLE AND INFRARED BACKGROUNDS
Laboratories for Applied Sciences, U. of Chicago, Ill., Summary rept., 1 May 1962-1 May 1963, Rept. no. LAS TR199 45, Sept. 1963, 88 p., AD 417 370.

SYMPOSIUM ON BACKGROUND RADIATION. ULTRAVIOLET, VISIBLE, AND INFRARED LEVELS AND DISTRIBUTIONS
Laboratories for Applied Sciences, U. of Chicago, Ill., Rept. no. LAS TR199 36, April 1963, 117 p., refs., AD 402 270.

. . . to explain or predict the levels of radiation, its probable variations, geographic distributions, geometric patterns and the effects of these parameters on background radiation levels.

OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY VOLUME II: SYSTEM TOPICS—PART ONE
General Electric Co., Philadelphia, Pa., Valley Forge Space Technology Center, Final Report, 7 Feb. 1964, 97 p., refs., N64-18132.

. . . effects of the atmosphere on laser propagation. The study supported the belief that optical communication has the potential to replace radio and to perform unique functions in many space situations . . .

Related Publications:

INVESTIGATION OF OPTICAL CROSS-E SECTIONS FOR LASER-RADAR
W. R. Rambauske, et al., Dayton Univ., Ohio, Research Inst., Rept. for 13 March 1961-1 March 1962, ASD TDR 62 726, 1 March 1962, 50 p., AD 422 055.

A METEOROLOGICAL STUDY OF COLD CLOUDS AS RELATED TO SATELLITE INFRARED HORIZON SENSORS
J. E. Alder, Stanford Research Inst., Menlo Park, Calif., AFCRL 63 413, Feb. 1963, 54 p., AD 407 974.

A cold cloud is defined as one that radiates infrared energy at low temperature (about 200 K). . . Efforts to design new sensors. . . Conditions favorable for cold clouds. . .

SPECTRA OF GIANT PULSES FROM A RUBY LASER
D. J. Bradley, et al., Nature, vol. 199, Sept. 28, 1963, p. 1281/1282, A63-25278.

Investigation of the spectral character of a giant pulse emitted by a ruby laser, in order to determine the suitability of this source for plasma light-scattering experiments. . . .

RESTORATION OF ATMOSPHERICALLY DISTORTED IMAGES
J. L. Harris, Visibility Lab., U. of Calif., San Diego, March 1963, 109 p., AD 404 873.

MODULATION TRANSFER FUNCTION ASSOCIATED WITH IMAGE TRANSMISSION THROUGH TURBULENT MEDIA
R. E. Hufnagel, et al., J. Opt. Soc. Amer., vol. 54, Jan. 1964, p. 52/61, 38 refs., A64-13037.

TEST OF SPECIAL RELATIVITY OR OF THE ISOTROPY OF SPACE BY USE OF INFRARED MASERS
T. S. Jaseja, et al., Phys. Rev., 2nd Series, vol. 133, March 2, 1964, p. A1221/A1225, 11 refs., A64-14959.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia U., New York, N. Y., Radiation Lab., Second Quarterly Progress Report, March 16 through June 15, 1963, CU-6-63-SC-90789, June 15, 1963, 71 p., refs., N63-20033.

. . . Detailed study of the microwave absorption of various gases present in planetary atmospheres is required for the full interpretation of the results that have been obtained by interplanetary radar.

RESEARCH STUDIES OF HIGH-DENSITY PLASMAS
L. Slama, et al., Electrical Engineering Research Lab., U. of Illinois, Urbana, Quarterly progress rept. no. 6, 15 Dec. 1962-15 March 1963, 15 March 1963, 21 p., AD 404 093.

Scattering experiments of laser beam were continued. Reduction of the spurious laser scattering to a tolerable level was accomplished. Studies of formation and motion of high-density plasma were made with a framing image-converter camera.

3B.413: Noise in Optical Communications Systems

Included: Noise in laser operations; Noise in incoherent radiation; Quantum noise; Signal-to-noise ratio in optical links; Spontaneous emission in laser amplifiers; Laser amplifier noise.

Not Included: Noise in communications links(1).

Cross References: Laser operation (Sect. 3B.34); Laser amplifiers (3B.370).

Principal Publications:

EFFECTS OF SKY NOISE ON OPTICAL COMMUNICATION WITH SPACE VEHICLES
G. Milne, et al., Institute of Optics, U. of Rochester, N.Y., RADC TR 61-149, 9 Nov. 1960, 44 p., AD 260 395.

Optical communication . . . will be influenced by the properties of the intervening atmosphere; any change in signal waveform introduced by the atmosphere can be regarded as sky noise. An extensive literature survey was undertaken to determine the magnitude and wavelength dependence of the various noise contributions. An experimental program revealed some aspects of scintillation.

A COMPARISON BETWEEN THERMAL AND QUANTUM NOISE IN RADIO RECEPTION
C. Ducot, Philips Res. Rep., vol. 17, no. 4, Aug. 1962, p. 382/392.

. . . comparison between disturbances due to thermal agitation and signal-energy quantization in radio reception, extended up to optical frequency ranges . . . disturbing effect of photon quantization in the received signal . . .

INVESTIGATION OF HIGH FREQUENCY LIMITATIONS IN MILLIMETER WAVE GENERATORS
J. Schwinger, Schwinger, Julian, Cambridge, Mass., Final rept., Jan-June 62, June 1962, 25 p., AD 276 940.

. . . Spontaneous emission is examined both for coherence and noise . . .

INCOHERENCE, QUANTUM FLUCTUATIONS, AND NOISE
I.R. Senitzky, Phys. Rev., vol. 128, no. 6, Dec. 1962, p. 2864/2870.

An examination is made of the relationship between the uncertainty principle and minimum amplifier noise. First, the concept of coherence is discussed, and an incoherence parameter is defined in terms of the uncertainty that enters into the uncertainty principle. Harmonic oscillator states are examined for coherence. The concept of noise is then discussed and contrasted with incoherence, noise referring to behaviour in time of a single system while incoherence involving comparison among members of an ensemble. It is shown, with illustrations, that the two concepts are different, and that an incoherent field of a cavity mode need not exhibit noise. . . .

INTERNAL NOISE AND SIGNAL-TO-NOISE RATIO OF A TUNED LASER AMPLIFIER
D.S. Bayley, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1111/1114.

If a laser preamplifier could be developed to have sufficiently low internal noise it would be possible to achieve nearly 100% quantum efficiency in optical receivers now limited, especially in the near IR region, by the low efficiency of available photo-emissive detectors. It is shown that under proper conditions such a low level of internal noise could be achieved in a tuned laser amplifier . . . design parameters of the amplifier . . . requirements on bandwidth and beamwidth . . .

RECEIVERS FOR LASER RADARS
R. L. Forward, Hughes Research Labs., Malibu, Calif., Interim engineering rept. no. 1, 15 Nov. 62 - 14 Feb. 63, 15 Feb. 1963, 22 p., AD 416 249.

. . . to investigate theoretically and experimentally the properties of a laser preamplifier . . . The signal-to-noise ratios of an optical signal were calculated after attentuation in a transmission medium and after amplification by four different systems (a photodetector, a single mode laser amplifier, a single mode optical heterodyne, and a laser preamplifier followed by an optical heterodyne). . . .

NOISE MEASUREMENT IN AN He-Ne LASER AMPLIFIER
R.A. Paananen, et al., Applied Physics Letters, vol. 4, April 15, 1964, p. 149/151, 7 refs., A64-17541.

Investigation of noise in a nonresonant laser amplifier. The theoretical noise corresponding to a single mode was calculated and used in the Planck radiation law to determine the equivalent input noise power per mode. The theoretical noise output was obtained by integrating the product of this distribution times the gain factor of the amplifier over the complete frequency range. . . .

QUANTUM EFFECTS AND NOISE IN OPTICAL COMMUNICATIONS (Correspondence)
M. Ross, Proc. IEEE, vol. 51, no. 4, April 1963, p. 602/603.

In reference to Gordon's paper on quantum effects in communications, it appears he did not discuss the case for channel capacity when the black-body background noise N is very much less than hfB, the quantum noise . . .

THE USE OF A LASER AMPLIFER IN A LASER COMMUNICATION SYSTEM (Correspondence)
H. Steinberg, Proc. IEEE, vol. 51, no. 6, June 1963, p. 943.

. . . The noise will be considered to arise from three sources: background at reception, spontaneous emission and photodetector shot noise. . . .

EFFECT OF NOISE ON LASER ACTION IN A BOUNDED PLANE-PARALLEL SLAB (Translation)
B.I. Stepanov, et al., Academy of Sciences, USSR, Bulletin, Physical Series, vol. 27, April 1964, p. 487/490, A64-17373.

. . . the effects of noise on the spectral width and angular distribution of the laser output in real laser systems. Considered is the case in which the noise is due to radiation incident to the slab from outside. . . .

SPONTANEOUS EMISSION IN LASER AMPLIFIER
W.H. Wells, JPL Space Progr. Summ., vol. 4, no. 37-21, April/May 1963, p. 183/187.

Reviewed as both a noise source and a power loss. The relation between SE and stimulated emission is expressed in terms of gain per unit length. The fundamental noise limit of laser amplifiers is considered along with two practical factors which increase noise above this limit owing to imperfect population inversion and imperfect spatial coherence.

STUDY OF NOISE IN SEMICONDUCTOR DEVICES
Minnesota U., Minneapolis, Quarterly rept. no. 1, 1 Aug.-30 Nov. 63, 30 Nov. 1963, lv., AD 436 874.

Equipment for stabilizing the operating point of FET's and for pulsing GaAs lasers has been built Noise measurements on Crystalonics FET's at low temperature revealed an excess noise that is not of the generalization-recombination types. . . .

Related Publications:

NOISE REDUCTION IN MICROWAVE TUBES
A.L. Eichenbaum, et al., David Sarnoff Research Center, Princeton, N.J., Semiannual rept. no. 1, 15 Oct. 62- 15 Apr. 63, 26 p., AD 410 938.

. . . it is expected that the photoemission induced by microwave-modulated laser light can be used as a source of known current modulation.

Section 3B.42

3B.420: Theoretical Background

Included: Pump supply facilities for lasers; Exfocal pumping of optical masers; Active imaging of lasers; Sun-pumped continuous lasers; Means for aiming laser beams; Spinning reflector units; Optical pump lamps; Laser pumping sources.

Not Included: Refrigeration systems.

Cross References: Auxiliary devices for laser operations (3B.347).

Principal Publications:

PULSE, MODULATION AND SCANNING TECHNIQUES (UV TO IR SPECTRAL REGION)
W.R. Wilson, Optical Communications Lab., Northwestern U., Evanstan, Ill., Quarterly rept. 2, 1 Sept.-30 Nov. 60, 17 p., AD 258 755.

. . . design and construction of an optical attentuator unit is described suitable for simulating vacuum range. This unit was designed to assist in the evaluation of the effectiveness of optical communication equipment . . . suggestions for the proper use of the attenuator unit to avoid errors in measurement are included.

STUDY AND INVESTIGATION OF ACQUISITION AND TRACKING OF OPTICAL COMMUNICATION SYSTEMS
R.F. Anderson, Philco Corp., Blue Bell, Pa., 1 Sept.-30 Nov. 61, Interim engineering rept. no. 2, Philco no. 9036-2, 30 Nov. 1961, 111 p., AD 270 448.

. . . establishing requirements, analyzing the tracking system, and examining techniques necessary for the investigation and design of the optical communications subsystem . . . interference between tracking and communications signals. . . . The maximum tracking rates between earth and lunar satellites are given. (See also AD 263 617, AD 276 564, AD 293 452.)

A NEW CONDENSER FOR A SUN-POWERED CONTINUOUS LASER
P. H. Keck, et al., Appl. Optics, vol. 2, Aug. 1963, p. 827/831, A63-21171.

. . . to concentrate sunlight effectively from a parabolic collector into a laser rod. . . .

HETERODYNE DETECTION IN OPTICAL COMMUNICATION
J. LaTourrette, et al. (editors), Technical Research Group, Syosset, N.Y., Technical note on Theoretical and Experimental Investigation of Broadband Coherent Optical Communication Techniques, Rept. no. TRG-168--TDR-1, RADC TDR 62-491, 30 Nov. 1962, lv. incl. illus. tables, refs., AD 296 362.

. . . preserves the signal-to-noise ratio in the detected difference frequency in the presence of incoherent noise . . . demultiplexing of channels, demodulation of FM and AM, Doppler and displacement measurements, and stabilization of LASERs is discussed. The elements of an optical communication link are discussed: LASERs, modulators, transmission path, and detectors.

THE SPINNING REFLECTOR TECHNIQUE FOR RUBY LASER PULSE CONTROL
R. C. Benson, et al., IEEE Trans. Mil. Electronics, vol. MIL-8, no. 1, Jan. 1964, p. 13/21.

. . . A method of obtaining high peak power pulses from a ruby laser oscillator by controlling the resonant cavity Q with a spinning reflector technique is described. . . . A theory regarding the multiple pulse problem of slow Q switching is presented. Practical methods of eliminating critical alignment procedures and increasing effective switching speed are explained. . . .

LASER PUMPING SOURCES
S. Byron, et al., Philco Corp., Philadelphia, Pa., Publi. no. U2520, 30 Jan. 1964, 47 p., AD 432 099.

HIGH INTENSITY PUMP FOR OPTICAL LASERS
G. L. Clark, et al., Electro-Optical Systems, Inc., Pasadena, Calif., Final rept., 1 July 62, 1 Apr 63, Rept. no. 3270, ASD TDR63 651, Aug. 1963, 113 p., AD 416 024.

. . . development, construction, and testing of a laser head in which the source of pump radiation is the dense hot plasma produced by electrically exploded wires . . .

SUN-PUMPED CONTINUOUS LASER
R. C. Duncan, Jr., et al., Radio Corp. of America, Princeton, N.J., In RCA, Camden, N.J., Lasers, 1963, p. 27, refs., N64-12567.

Laser action has been achieved in a CaF_2: Dy^{2+} system at liquid-neon temperature (27^oK) using the sun as the pumping source . . . The low pulsed laser threshold, the long lifetime and the convenient location of the broad pumping bands of this system make it especially suitable for sun-pumped operation.

ACTIVE IMAGING
W. A. Hardy, Nature, vol. 202, April 18, 1964, p. 277/278, A64-17334.

VARIATION OF ARC RESISTANCE AND ARC POWER WITH CURRENT IN PULSED XENON OPTICAL PUMP LAMPS (Correspondence)
H. G. Heard, Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1234/1235.

Several papers have appeared that refer to the constant value of arc resistance in optical pumping lamps. We report the results of extensive measurements on linear, helical, and concentric flash lamps that reveal the current-dependent character of arc resistance. The effects of discharge circuit parameter variation upon arc impedance are included. . . .

DESIGNING LASERS WITH PUMP-POWER CHARTS
R. A. Kaplan, Electronics, vol. 36, Dec. 27, 1963, p. 23/28, A64-13593.

A MEANS OF AIMING A LASER BEAM
L. W. Nichols, Naval Ordnance Test Station, China Lake, Calif., NOTS TR3446, NAVWEPS 8481, Jan. 1964, 4 p., AD 429 341.

The retrodirective reflecting properties of a corner reflector can be used to aim a laser beam. When portions of a corner reflector are placed in front of a laser and its aiming telescope, then an image of the laser beam is superimposed on the telescope image to show the exact target area being illuminated by the beam.

COHERENT OPTICAL BEAM STEERING TECHNIQUES
L. W. Procopio, et al., Philco Corp., Blue Bell, Pa., Final rept. 27 Dec 62-15 Sep 63, RADC TDR 63 450, vol. 1, Jan. 1964, 103 p., AD 428 203.

The technical problems involved in achieving an electronically scanned coherent optical phased array are examined in detail. . . . including studies of coherent optical components, optical losses, limitations imposed by propagation effects, and radiation patterns generated by laser elements . . . Techniques to achieve both electronic steering of a single laser beam and a phased array of lasers are analyzed. . . .

COHERENT OPTICAL BEAM STEERING TECHNIQUES
L.W. Procopio, et al., Philco Corp., Blue Bell, Pa., RADC TDR63 450, vol. 2, Jan. 1964, 209 p., AD 428 670.

EXFOCAL PUMPING OF OPTICAL MASERS IN ELLIPTICAL MIRRORS
D. Roess, Appl. Optics, vol. 3, Feb. 1964, p. 259/265, 11 refs., A64-14260.

EXPERIMENTAL VERIFICATION OF SUN-POWERED LASER TRANSMITTER
G.R. Simpson, American Optical Co., Southbridge, Mass., Final rept., Mar 62-May 63, ASD TDR 63 727, Aug. 1963, 110 p., AD 420 983.

. . . design and experimentation leading to the delivery of an experimental model of a sun-powered laser transmitter. . . . design of the cooling system . . . Experimental evaluation of a number of laser configurations . . .

Related Publications:

AN INVESTIGATION OF THE OUTPUT OF A GAS LASER WITH VARIATION OF PARAMETERS
J.D. Hunsuck, Air Force Inst. of Tech., Wright-Patterson Air Force Base, Ohio, Rept. no. GE/EE/62-9, Master's thesis, Dec. 1962, 30 p. incl. illus. table, 8 refs., AD 294 923.

. . . Design criteria and accuracy of adjustments . . . requirement of temperature compensation . . . theory of operation of the helium-neon gas laser . . . laser interferometer . . . Mode patterns . . . Stability of the laser . . .

RECEIVERS FOR LASER RADARS
R.L. Forward, Hughes Research Labs., Malibu, Calif., Interim engineering rept. no. 1, 15 Nov 62 - 14 Feb 63, 15 Feb. 1963, 22 p., AD 416 249.

TRANSMITTERS AND RECEIVERS FOR OPTICAL COMMUNICATIONS
J.R. McDermott, Space/Aeronautics, vol. 39, June 1963, p. 98/106, 38 refs., A63-18060.

. . . optical transmitters using a CW helium-neon laser for microwave modulation of the beam . . . optical antenna as the beam-forming optics . . . General Telephone's optical transmitter-receiver system for TV-video signal transmission by microwave modulation of the laser beam. Noted are the use of the Pockels-effect microwave modulating cavity for microwave modulation, and the application of the superheterodyne principle to the reception of advanced types of modulation.

Section 3B.43

3B.430: Special Techniques in Optical Communications System

Included: Pulsed light communications; Sun-powered communications systems; Solar communications systems; Communications by deflected sunlight; Retroreflective optical communications systems; Passive reflective relays in optical communications; Retrometer.

Not Included: Semi-passive communications satellites (4A); Optical antennas.

Cross References: Pulsed laser operation (Sect. 3B.34).

Principal Publications:

COMMUNICATION IN SPACE BY DEFLECTED SUNLIGHT
K.W. Otten, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 367/372.

SPACE SIGNAL SYSTEM USES SUN'S ENERGY
Aviation Week, vol. 72, no. 18, May 1960, p. 164/167.

Details of an experimental optical space communications system which will use the sun's radiant energy as an intelligence carrier are being revealed here this week. Known as communications system (SOCOM), is in development at Electro-Optical Systems, Inc. with Air Force backing under a $467,237 contract from the Wright Air Development Division.

DIRECT USE OF SOLAR-ENERGY FOR COMMUNICATION. PART I. ANALYSIS OF SOLAR-OPTICAL COMMUNICATION
D.E. Erway, et al., Electro-Optical Systems, Inc., Pasadena, Calif., Rept. 270, ASD TR 61-13, pt. 1, Sept. 1961, lv., AD 269 430.

. . . analytical part of the SOCOM (Solar Optical Communications) program consisted of studies . . . of space communication systems using sunlight as a carrier, together with exploration of ways of simulating and testing such systems on the earth. The areas studied included: wavelength spectrum, optical systems, modulation and demodulation techniques, tracking and stabilization problems, system design, and simulation techniques.

PULSED LIGHT INVESTIGATION
W.J. Nolan, Jr., Motorola, Inc., Riverside, Calif., Rept.RLI-3854-4, Dec. 1961, 21 p., AD 268 281.

. . . By using vinyl plastic sleeving as the wall of the spark discharge chamber, repeated discharges in oil at an energy level above 20 joules were sustained. The spark duration, as measured by its luminous output, is approximately 2 microseconds, with the particular capacitor and electrode structure used.

STUDY OF PULSED LIGHT AMPLIFIERS
R. L. Beurle, et al., English Electric Valve Co., Ltd. (Gr. Brit.), Rept. no. 40/2-5, Dec. 1962, 6 p. incl. illus., AD 296 099.

MODULATION OF XENON ARC LAMPS
J. K. Buckley, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 154/161.

DIRECT USE OF SOLAR ENERGY FOR COMMUNICATION. PART II. CONSTRUCTION AND TEST OF EXPERIMENTAL EQUIPMENT
D. E. Erway, et al., Electro-Optical Systems, Inc., Pasadena, Calif., Final Rept., pt. 2, EOS rept. no. 270, ASD TR 61-13, pt. 2, Feb. 1962, 85 p. incl. illus., AD 276 270.

. . . solar optical communication system . . . design, fabrication and test of a system based upon results of analytical study. . . . For space links, AM/IM modulation appears best for low information rates. For transmission through atmosphere an FM/IM system appears to be best. For high information rates, the optimum light modulator remains to be developed. Some improvement in system performance is possible by use of improved detectors.

EXPERIMENTAL VERIFICATION OF SUN POWERED LASER TRANSMITTER
D. A. LaMarre, et al., American Optical Co., Southbridge, Mass., Interim engineering rept. no. 2, Aug-Nov 62, Nov. 1962, 41 p., AD 437 864.

. . . design leading to the delivery of an experimental model of a sun-powered laser transmitter. . . . Experimental Nd-doped glass lasers are discussed in both the short- and long-fiber configurations. (See also AD 437 865.)

HOLLOW-CATHODE GENERATOR OF NANOSECOND LIGHT PULSES
R. W. Lomax, et al., Elect. Commun., vol. 37, no. 4, 1962, p. 367/376.

DIE ERZEUGUNG SEHR KURZER UND INTENSIVER UV-LICHTIMPULSE (Production of Ultrashort UV Light Pulses of High Intensity) (In German)
L. Frommhold, Zeitschrift fur Naturforschung, vol. 18, May 1963, p. 590/593, A63-24227.

Description of a spark source which uses a Kerr cell as a light valve to produce light pulses of the order of 5×10^{-9} sec. . . .

COHERENT LIGHT COMMUNICATION SYSTEM
E. Gerjuoy, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 291/292.

Brief Summary only. A communications system is proposed which utilizes light generated by a single optical maser for two-way communication. The complications involved in generating and directing the light beam occurs only at one point -- the master station. The return beam, from the substation to the master station, is established by means of a retrodirective reflector at the substation. The range-intensity relationship for such a system has been evaluated for some typical parameters. . . .

DESIGN CONSIDERATIONS FOR LASER PULSE AMPLIFIERS
A. E. Siegman, J. Appl. Phys., vol. 35, Feb. 1964, p. 460, A64-14797.

. . . various alternative forms . . . results from a previous study concerning the time varying amplification of a pulse of radiation passing through an idealized laser amplifier, neglecting pumping during the passage of the pulse . . .

EXPERIMENTAL VERIFICATION OF SUN-POWERED LASER TRANSMITTER
G. R. Simpson, American Optical Co., Southbridge, Mass., Final rept., Mar 62-May 63, ASD TDR 63727, Aug. 1963, 110 p., AD 420 983.

. . . design and experimentation leading to the delivery of an experimental model of a sun-powered laser transmitter. . . . design of the cooling system . . . Experimental evaluation of a number of laser configurations . . .

THE RETROMETER: A LIGHT-BEAM COMMUNICATIONS SYSTEM
N. E. Thomas, National Aeronautics and Space Administration, Langley Research Center, Langley Station, Virginia, Washington, NASA, March 1964, 20 p., N64-18503.

A new system of voice communications transmitted on a beam of light is described. It differs from prior systems in that the originating station requires no power other than that of the human voice . . .

Related Publications:

THE PULSED LIGHT THEODOLITE
L. A. Jay, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 35/36.

A new theodolite has joined the family of weather observation equipment used by the

Meteorology Department of the United States Army . . . It is the Pulse Light Theodolite (PLT) which may replace all present theodolites for accurate, low level wind observations because of its speed of operation and reduced man-power requirements. For many years double theodolite observations of a balloon in free flight have been considered the most accurate and reliable of all methods of determining low level winds. . . .

ANALYSIS OF A PULSED-LIGHT DEEP-OCEAN SEARCH SYSTEM
R. D. Hitchcock, Naval Civil Engineering Lab., Port Hueneme, Calif., Technical rept. no. R-209, 23 Nov. 1962, 29 p. incl. illus. table, 38 refs., AD 291 697.

Section 3B.47

Optical Communications in Special Wave Bands

3B.472: Infrared Transmission Methods

Included: Infrared technology in general; Infrared transmission components.

Not Included: Infrared sensors (3A).

Cross References: Propagation effects in the infrared region (3B.412); Quasi-optical communications techniques (Div. 3B.2); Intermediate range between microwave and IR (Div. 3B.5).

Principal Publications:

INFRARED COMMUNICATIONS RECEIVER FOR SPACE VEHICLES
W. E. Osborne, Electronics, vol. 32, no. 38, Sept. 1959, p. 38/39.

Experimental communications receiver operating at infrared frequencies may be used for future space vehicles. Circuits reject solar infrared noise.

INFRA-RED RADAR, SURVEILLANCE AND COMMUNICATIONS. PART 2
C. M. Cade, Brit. Commun. and Electronics, vol. 7, no. 7, July 1960, p. 510/517.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia Radiation Lab., New York, Quarterly prog. rept. 5, 16 Dec 60-15 Mar 61, 43 p., Rept. CU-3-61-SC-78330, AD 256 477.

Radioastronomical measurements are in progress using the 10-cm maser amplifier. Further progress is described on the M-band radioastronomy system. Work on the cesium infrared maser and several experiments using a pulsed ruby optical maser are described. A theoretical treatment for dielectric microwave resonators is outlined, along with experimental confirmation.

A RESEARCH PROGRAM ON THE UTILIZATION OF COHERENT LIGHT
D. J. Blattner, et al., David Sarnoff Research Center, Princeton, N. J., Interim rept. no. 6, 1 Oct-31 Dec 62, 20 Jan. 1963, 28 p. incl. illus., 11 refs., AD 296 145.

. . . a demonstration of an optical maser communication system carrying an audio channel . . .

TRANSMISSION OF THE ATMOSPHERE IN THE INFRARED. A REVIEW
J. N. Howard, et al., Air Force Cambridge Research Labs., Bedford, Mass., Rept. no. AFCRL 62-814, Air Force Surveys in Geophysics no. 150, July 1962, 24 p. incl. illus. tables, refs., AD 289 530.

. . . reviews and summarizes our knowledge of infrared atmospheric transmission and discusses the work that has been done in the past two or three years. Both the theoretical and experimental efforts are covered. . .

MODERN INFRARED TECHNOLOGY
B. Kemp, Indiana, Howard W. Sams and Co., Inc., 1962, 256 p.

The principles and applications of infrared energy in established and in many new and possible uses are discussed at a level which should prove adaptable to engineers and students alike. . . .

ELEMENTS OF INFRARED TECHNOLOGY
P. W. Kruse, et al., New York, John Wiley and Sons, Inc., 1962, 435 p.

Infrared radiation - its generation, propagation, and detection - . . .

STUDY OF ADVANCED SOLID STATE INFRARED DETECTION
D. W. Nyberg, et al., Boeing Co., Renton, Wash., Final Rept., Sept. 60-Nov. 62, Rept. no. D6-8895, ASD TDR 62-997, Nov. 1962, 229 p., AD 298 002.

SOME ELECTRONICS PROBLEMS IN INFRARED SYSTEMS DESIGN
F. G. Whelan, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 542/548.

SORTI. ELECTRO-OPTICAL EQUIPMENT RESEARCH
Valley Forge Space Technology Center, Philadelphia, Pa., 22 June 1962, 19 p., AD 406 897.

The SORTI concept embodies the capability for achieving precise ICBM tracking and intercept point prediction accuracies. . . . highly sensitive electro-optical image-forming equipment . . . dependent upon the infra-red vidicon for its mission. . . .

PROPOSAL: THE GENERATION OF COHERENT INFRARED RADIATION FROM A DIFFRACTION GRATING
G. R. Bird, IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 432, A64-11537.

UNCOOLED IR DETECTOR FOR THE TEN MICRON REGION
W. D. Brennan, IIT Research Inst., Chicago Ill., Quarterly rept. no. 1, 1 Mar-31 May 63, Rept. no. ARF16032 3, 10 June 1963, 23 p., AD 413 975.

A sample holder and flash apparatus were constructed for measuring the photoconductive response of cadmium sulfide crystals to microsecond pulses of light. The aim of this research is to obtain evidence of photoconductivity due to the thermal ionization of neutral particles generated by the light. . . .

NARROW BANDWIDTH TUNABLE INFRARED DETECTORS
M. A. C. S. Brown, et al., Brit. Commun. and Electronics, vol. 10, Aug. 1963, p. 608/612, A63-20911.

Discussion of the limitations of available detectors in the IR region. A method is suggested for overcoming the disadvantages to some extent by the use of a tunable device . . .

STIMULATED EMISSION IN THE FAR INFRA-RED
A. Crocker, et al., Nature, vol. 201, Jan. 18, 1964, p. 250/251, A64-14149.

MODULATED INFRARED DIODE SPANS 30 MILES
R. J. Keyes, et al., Electronics, vol. 36, April 5, 1963, p. 38/39, A63-14944.

Description of a communications experiment with a gallium arsenide diode transmitting audio and visual signals over a 30 nautical mile path, with 8,400 Å emission. The experiment demonstrates the ability of the GaAs diode to function as a long-distance communications device during good weather.

MODULATION OF INFRARED BY FREE CARRIER ABSORPTION
R. B. McQuistan, et al., J. Appl. Phys., vol. 35, April 1964, p. 1243/1248, 11 refs., A64-16965.

Application of the phenomenon of free carrier absorption in germanium to the modulation of IR radiation . . . Modulators have been fabricated having modulation bandwidths in the range 10^5 to 10^6 cps. Experimentally determined modulator characteristics are compared with theoretical predictions.

METHODS OF MODULATING INFRARED RADIATION
T. S. Moss, Royal Aircraft Establishment, Farnborough (Gt. Brit.), In AGARD, Paris, Light and Heat Sensing, 1963, p. 207/220, refs., N64-15468.

. . . emphasis on systems that can operate at very high frequencies, the aim being to modulate up to $\sim 10^{10}$ c/s . . . Devices using pure field effects have negligible delay times and are potentially capable of operating at the highest frequencies desired. Frequency response and degree of modulation are estimated in terms of fundamental limitations and of practical materials.

COHERENT INFRARED LASER
M. W. Muller, Varian Associates, Palo Alto, Calif., Rept. no. 3141S, 16 Dec. 1963, 22 p., AD 428 562.

Techniques of obtaining population inversions among vibrational energy levels of molecules are presented . . .

A FAR INFRARED BIBLIOGRAPHY
E. D. Palik, Naval Research Lab., Washington, D. C., NRL Bibliography no. 21, April 1963, 51 p., AD 407 047.

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M. J. Persky, Block Associates, Inc., Cambridge, Mass., Final rept., 31 May 1963, 174 p., AD 411 820.

. . . two infrared interferometer spectrometers for the balloon-borne measurement of atmospheric radiance is described. . . .

NEAR INFRARED BACKGROUND CLUTTER AND ATMOSPHERIC TRANSMISSION
E. C. Reifenstein, III, et al., Arthur D. Little, Inc., Cambridge, Mass., Semiannual rept., SSD TDR63 146, May 1963, 9 p., AD 407 251.

. . . to obtain infrared background data from a U-2 aircraft that will assist in the design and evaluation of future space-based infrared detection systems.

INFRARED PHOTOCONDUCTORS (Summary Report)
M. L. Schultz, Radio Corp. of America, RCA Labs., Princeton, N. J., David Sarnoff Research Center, Dec. 31, 1963, 62 p., 11 refs., N63-17084.

OPTICAL AND INFRARED MASERS
J. Siddoway, et al., JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 137/148.

Traveling wave amplifier. . . . reported in SPS 37-23, vol IV. The small signal gain of the system at 3.4$\mu$is 40 db for 12 passes of the laser beam. . . . optical system . . . shown in Fig. 7. It appears feasible to build a maser as a source of coherent radiation in the far infrared. The means of excitation is analogous to a heat engine.

SOME FUNDAMENTALS OF INFRARED TECHNOLOGY AND INFRARED DATA REDUCTION ON THE ATLANTIC MISSILE RANGE
E.S. Smith, RCA Service Co., Patrick AFB, Fla., MTC-TDR-63-6, May 1963, 152 p., 15 refs., N63-20710.

INFRARED — TODAY AND TOMORROW
I. J. Spiro, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR269 4526 10 1, SSD TDR 63 238, 4 March 1964, 26 p., AD 434 358.

. . . The current state-of-the-art of infrared technology, both civilian and military is outlined, and some future improvements and developments are predicted . . .

DETECTION RANGE PREDICTION FOR INFRARED DETECTION SYSTEMS
N.C. Stirling, Proc. IEEE, vol. 51, no. 10, Oct. 1963, p. 1327/1336.

INFRARED TRANSMISSION STUDIES. VOLUME III. THE INFRARED ABSORPTION OF CARBON DIOXIDE
V.R. Stull, et al., Aeronutronic, Newport Beach, Calif., Final rept., SSD-TDR-62-127, 31 Jan. 1963, 1 v., incl. illus., tables, AD 400 959.

. . . has been calculated over a wide range of path length, pressure, and temperature . . . The results are presented in extensive tables . . .

INFRARED TECHNIQUES IN MILITARY PRACTICE (In Russian)
Yu. A. Tyapkin and B.V. Tyapkin, Moscow, Sovetskoye Radio, 1963, 360 p.

. . . emission, propagation and reception of infrared waves . . . details of infrared devices . . . recent research and developments in the field of recording and propagating radiant energy . . . instrument systems for resolving problems of photography, prospecting, night vision, communications and jamming, sighting, navigation and detecting heat-emitting targets. . . . provides a manual on the subject for a wide range of military experts. . . .

DETECTOR INVESTIGATION FOR 8-15 AND 100-4000 MICRON REGIONS
R.F. Wallis, et al., Naval Research Lab., Washington, D.C., Summary rept., 1 July 1961-30 June 1963, NRL 5996, 29 Aug. 1963, 48 p., AD 419 573.

. . . theoretical and experimental work . . . on photoconductive, long-wavelength detectors, a boron-doped germanium detector . . . Putley infrared detector . . . For 4-mm-wavelength radiation . . .

A FAR INFRARED PROPOSAL
W.H. Wells, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 121/124.

A coherent radiation source in the far infrared (IR) has been proposed and studied theoretically. This work is extended two ways. First, we show the possibility of several atmospheric absorption windows in the far IR, provided one transmits only through dry atmosphere above a mountain peak. . . . Second, we improve the estimate of output power from the proposed maser oscillators, which is the order of a microwatt, and show that about 5% transmission at the output mirror is required to realize it.

INFRARED TECHNOLOGY AND AEROSPACE SYSTEMS
Weather Group (4th), Andrews AFB, Washington, D.C., 1 March 1964, 36 p., AD 434 323.

. . . to present some of the basic elements . . . especially those elements that are affected by the earth's atmosphere. The discussion follows this sequence: infrared physics, maximum emissions, IR detectors, atmospheric effects, missile defense systems, attitude control, and meteorological satellites.

Related Publications:

RESEARCH ON ATMOSPHERIC ATTENUATION OF INFRARED RADIATION
L.M. Biberman, Chicago Midway Labs., U. of Chicago, Ill., Progress rept. no. 1, Rept. no. CML-L-E173-1, 30 June 1959, 18 p., incl. illus., tables, AD 401 362.

INFRARED FIBER OPTICS
D.A. Pontarelli, et al., Armour Research Foundation, Chicago, Ill., Quarterly progress rept. 7, Rept. ARF 1139-19, 27 Dec. 1960, 6 p., AD 250 458.

A SPACE BACKGROUND STUDY
P. Barnhart, et al., Eastman Kodak Co., Rochester, N.Y., Semi-Annual rept., 1 Jan-1 July 1962, Rept. no. EK/ARD ED-874, 31 July 1962, 31 p., incl. illus., AD 281 724.

. . . to characterize the space background in the infrared spectral region. Many possible causes for previous measurement errors are discussed. . . .

INTERET COMPARE DES RADIOMETRIES INFRAROUGE ET HERTZIENNES (Comparison Between Microwave and Infrared Radiometric Observations) (In French)
G. Broussaud, et al., Ann. Radioelect, vol. 18, no. 72, April 1963, p. 89/111.

After first recalling the laws governing the emission, transmission and collection of thermodynamic radiation, the authors show that the passive detection of bodies around us is restricted to a very small number of frequency bands, the 35 and 100 Gc/s bands for microwaves, and 30 and 80 Tc/s for infra-red. The existence of these favored bands is the result of compromise between the emmissivity of the bodies themselves, the atmosphere's transparent windows and receiver performance. . . .

PROPOSED EXPERIMENTAL TEST OF COSMOLOGICAL THEORY BY INFRARED MEASUREMENTS
R.R. Law, Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1180/1190.

INFRARED BAND HANDBOOK
Edited by Herman A. Szymanski, New York, Plenum Press, 1963, 484 p., A64-17258.

Band positions of organic and inorganic compounds are tabulated. The handbook is intended for chemists and physicists for use in identifying unknown compounds, assigning group frequencies, determining the most advantageous sample conditions, and comparing series of related compounds for similar vibrations. . . .

3B.473: Ultra Violet Transmission Methods

Included: Ultra violet transmission conditions.

Not Included: Geophysics; Astrophysics; Atomic and molecular physics.

Cross References: X-ray and gamma ray communications (Div. 3B.5); UV quartz lasers (3B.348).

Principal Publications:

SOLAR BLIND PHOTODIODES HAVING MAXIMUM SENSITIVITY IN THE MIDDLE ULTRAVIOLET
G.G. Kretchmar, Naval Ordnance Lab., Corona, Calif., In Chicago U., Ill., Labs for Appl. Sci., Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14-15, 1960, p. 75/86, 3 refs., N63-20856.

ULTRAVIOLET MAY HAVE SPACE SIGNAL VALUE
B. Miller, Aviation Week, vol. 72, no. 8, Feb. 1960, p. 63/69.

DEVELOPMENT OF A FAST SOLID-STATE ULTRAVIOLET PHOTODETECTOR
D.E. Brown, et al., Institute of Science and Tech., U. of Michigan, Ann Arbor, Final rept., June 1961-Aug. 1961, March 1963, 33 p., AD 404 912.

A SOURCE AND DETECTOR OF RADIATION IN THE WAVELENGTH REGION 1500-50 ANGSTROMS SUITABLE FOR RADIATION EFFECTS STUDIES ON MATERIALS IN VACUO
H.R. Moore, Electro-Optical Systems, Inc., Pasadena, Calif., Wright Patterson AFB, Ohio, Aeron. Systems Div., WADD TR 60-371, July 1961, 49 p., 55 refs., N63-19325.

The principle of the radiation source is the repetitive pulsed discharge of a capacitor stored energy into a ceramic discharge tube. A very hot plasma will thus be generated which will emit vacuum ultraviolet radiation by Bremsstrahlung-like processes.

ULTRACOM — ULTRAVIOLET COMMUNICATIONS SYSTEM
J.W. Ogland, Nat. Symp. Global Commun., May 1961, p. 6/9.

PULSE, MODULATION AND SCANNING TECHNIQUES (UV TO IR SPECTRAL REGION)
W.R. Wilson, Optical Communications Lab., Northwestern U., Evanston, Ill., 1 June 1960-15 Aug. 1961, Final rept., 15 Aug. 1961, 13 p., AD 266 156, AD 261 925.

The spectral sensitivities of experimental solar blind multiplier phototubes were determined with the aid of a calibrated mercury arc ultraviolet (UV) source. . . . the design and construction of an improved optical attenuator for the simulation of vacuum range was completed. . . . a sruvey of the techniques employed for modulating light sources was made.

PARAMETERS PERTINENT TO THE DETECTION OF ULTRA-VIOLET RADIATION IN SPACE-TO-SPACE CONFIGURATIONS
L. Glatt, STL, Inc., Los Angeles, Calif., Rept. no. 6110-7244-RU-000, June 1962, 86 p., incl. illus., 3 refs., AD 281 910.

SYMPOSIUM ON MILITARY APPLICATIONS OF ULTRAVIOLET RADIATIONS
P. E. LeBlanc, et al., Laboratories for Applied Sciences, U. of Chicago, Ill., Rept. no. LAS-TR-199-37, Nov. 1962, 178 p., incl. illus., tables, refs., AD 299 545, N63-20851.

Contents: Survey of optical materials . . . Photoemissive detectors . . . Solar-blind photodiodes . . . metallic cathode solar-blind photomultipliers . . . An ultraviolet sensitive image tube.

ULTRAVIOLET TRANSMITTER DESIGN AND DEVELOPMENT PROGRAM
E. Wolf, Sylvania Electronics Systems, Buffalo, N. Y., ASD TDR 63-69, Dec. 1962, 1 v., incl. illus., AD 297 894, AD 283 588.

. . . for long range space communications . . . included a systems study, development of an ultraviolet CW laser. . . of two modulation techniques, and a radiation detector survey. . . . two novel modulation techniques . . . polarization modulation, and an interference filter modulator. . . . the former system . . . provides a signal-to-noise ratio at the receiver greater than that in the intensity modulated case.

DEVELOPMENT OF A FAST SOLID-STATE ULTRAVIOLET PHOTODETECTOR
D. E. Brown, et al., Michigan U. Inst. of Science and Tech., Ann Arbor, Wright Patterson AFB, Ohio, Electronic Tech. Lab., Final Rept., June 1961-Aug. 1962, Rept. 4611-13-F, ASD-TDR-62-978, March 1963, 39 p., 12 refs., N63-16404.

. . . Efforts were concentrated on photovoltaic devices using metal semiconductor barrier layers. . . .

MIDDLE ULTRAVIOLET PHOTOELECTRIC DETECTION TECHNIQUES
L. Dunkelman, et al., NASA, Goddard Space Flight Center, Greenbelt, Md., In its Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962, May 1963, p. 125/137, 15 refs., N63-17111.

. . . When near ultraviolet and longer wavelength radiation must be rejected to a greater degree, "solar blind" photocathodes, with higher work functions, such as the alkali tellurides, can be used. These photodetectors, their calibration, and their applications are discussed.

ENHANCED ULTRAVIOLET OUTPUT FROM DOUBLE-PULSED FLASH LAMPS
J. L. Emmett, et al., Stanford U., Calif., 1963, 12 p., 1 ref., N63-17140.

Measurements of the spectral output as a function of current density of the high peak light intensity from commercial xenon flash lamps . . .

DIE ERZEUGUNG SEHR KURZER UND INTENSIVER UV-LICHTIMPULSE (Production of Ultrashort UV Light Pulses of High Intensity) (In German)
L. Frommhold, Zeitschrift fur Naturforschung, vol. 18, May 1963, p. 590/593, 22 refs., A63-24227.

Description of a spark source which uses a Kerr cell as a light valve to produce light pulses of the order of 5×10^{-9} sec. . . .

BIBLIOGRAPHY OF VACUUM ULTRAVIOLET SPECTROSCOPY
R. C. Hirt, et al., American Cyanamid Co., Stamford, Conn., ASD TDR 62-915, Feb. 1963, 44 p., AD 401 498.

. . . arranged alphabetically by senior author, with a four-letter code (called CODEN) for the journal reference. The format and presentation are suited for easy punching onto IBM punched cards for machine sorting. A subject index is provided to the more than 1300 references.

INVESTIGATION OF SPECIAL ULTRAVIOLET TECHNIQUES
E. Langberg, et al., Elcon Lab. Inc., Peabody Mass., Final rept., 1 May 1962-15 Nov. 1963, Rept. no. 12 R1 64 3, 15 Nov. 1963, 80 p., AD 434 063.

Descriptors: Optical equipment . . . Communication equipment . . . Ultraviolet communication systems . . .

PROPOSED STANDARD WAVELENGTHS IN THE VACUUM ULTRA-VIOLET: SPECTRA OF Ge, Ne, C, Hg, AND N
P. G. Wilkinson, et al., J. Opt. Soc. Amer., vol. 53, June 1963, p. 710/717, 36 refs., A63-20184.

. . . spectrum emitted from a germanium hollow-cathode discharge, photographed at high dispersion in the third order of a 21-ft. concave grating spectrograph. . . .

Related Publications:

ULTRAVIOLET INSTRUMENTATION FOR CELESCOPE-AN ASTROPHYSICAL RECONNAISSANCE SATELLITE
R. J. Davis, et al., Appl. Optics, vol. 1, March 1962, p. 131/137.

QUARTZ ULTRAVIOLET LASERS (Correspondence)
C. H. Becker, et al., Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 358/359.

QUARTZ ULTRAVIOLET LASERS
C. H. Becker, IEEE Internat. Conv. Rec., vol. 11, no. 3, March 1963, p. 75/78.

UV EXCITON LASER (Correspondence)
E. L. Fink, Proc. IEEE, vol. 51, no. 6, June 1963, p. 951.

DIVISION 3B.5
POTENTIAL FUTURE COMMUNICATIONS TECHNIQUES

The requirements for future space communications call for greatly increased information transmission capacity at ranges beyond the dimensions of the solar system. It is very likely that present technologies will not be able to fulfill these requirements. It is believed that fundamental limitations of present space communications techniques, including those of optical transmission methods, are recognized. All these methods still offer a definable margin for improvement which, for some systems, extends over several orders of magnitude. Development efforts are under way to reduce this margin between theoretical capabilities and actual performance.

Beyond this definable improvement, engineers must seek novel technologies. This division includes references to efforts and publications which may be pertinent to future communications techniques.

The division contains sections on relativity theory (3B.51), plasma devices (3B.52), extended electromagnetic frequency ranges including X-rays and gamma rays (3B.53) and gravitational fields and waves (3B.54).

A section on novel propulsion methods for space flight may be of interest because they may have potential for interference with the communications operations (3B.57).

A catch-all section concludes the division (3B.58). It contains references to occasional suggestions for additional possibilities for performing space communications functions, including surface communications on other, still unexplored, celestial objects.

Section 3B.51:

3B.510: Relativity and space electronics

Included: Astorelativity; Signal propagation in a positive definite Riemannian space; Tests of special relativity; Measurement and prediction of the propagation velocity of electromagnetic waves; Relativistic plasma; General relativity "force" on a satellite; Generation of millimeter waves by a relativistic Doppler effect; Relativistic problem of Earth's motion through space; Relativistic equations for Doppler Effect; Clock paradox.

Not Included: Theoretical physics; Fundamentals of relativity theory; Worldwide timing systems.

Principal Publications:

SHORT-TIME MEASUREMENT OF TIME DILATION IN AN EARTH SATELLITE
R. S. Badessa, et al., Phys. Rev. Letters, vol. 3, July 1959, p. 79/80.

A method for measuring the gravitational red shift based on the variation of the frequency difference between two oscillators as a function of altitude.

RELATIVITY AND SPACE TRAVEL
J. R. Pierce, Proc. IRE, vol. 47, June 1959, p. 1053, 1061.

DISCUSSION OF RELATIVITY AND SPACE TRAVEL
Proc. IRE, vol. 47, Oct. 1959, p. 1778/1780.

H. L. Armstrong - "Comment on Relativity and Space Travel." H. Unz - "The Clock Paradox." C. W. Carnahan - "Relativity and Space Travel." C. P. Gadsden - "The Clock Paradox." J. R. Pierce - "The Clock Paradox."

APPLICATIONS OF DOPPLER MEASUREMENTS TO PROBLEMS IN RELATIVITY, SPACE PROBE TRACKING, AND GEODESY
R. R. Newton, Proc. IRE, vol. 48, no. 4, April 1960, p. 754/758.

THE FRINGE OF THE FIELD. THE RED SHIFT
Electronic Tech., vol. 37, July 1960, p. 267/269.

Of three phenomena calculated by the general theory of relativity, two were adequately verified about 40 years ago and were, indeed, responsible for the great popular interest in the subject at that time. The third effect, the "gravitational red-shift", can be thought of as a retardation time, and hence a reduction in frequency, of radiation that is making its way outwards from the gravitational attraction of the source . . .

GENERAL RELATIVITY FOR THE EXPERIMENTALIST
R. L. Forward, Proc. IRE, vol. 49, May 1961, p. 892/904.

RELATIVITY AND THE CLOCK PARADOX (Correspondence)
A. Roth, Proc. IRE, vol. 49, Sept. 1961, p. 1437.

A PROPOSED FIRST-ORDER RELATIVITY TEST USING LASERS (Correspondence)
C.W. Carnahan, Proc. IRE, vol. 50, no. 9, Sept. 1962, p. 1976.

The new-found ability to mix together the outputs of two coherent optical sources, such as gas lasers, and obtain stable beats, raises the possibility of new test for ether drift . . .

THE "CLOCK PARADOX" IN THE THEORY OF RELATIVITY
I. I. Gol'denblatt, Applied Physics Lab., Silver Spring, Md., Sept. 17, 1962, 11 p., 7 refs., Transl. into English from lgv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 6 1961, p. 38/42, N63-21916.

. . . analyzed on the basis of a detailed study of the behavior of time in comparable coordinate systems.

A PHILOSOPHICAL ANALYSIS OF THE SPECIAL THEORY OF RELATIVITY
L. Janossy, Emmanuel Coll. Research Language Center, Boston, Mass., Final rept., June 1962, 33 p., (Trans. from Questions on Philosophy, no. 9, p. 89/104, 1961) AD 298 107.

ASTRORELATIVITY
H. G. L. Krause, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala., May 22, 1962, 64 p., 28 refs., N63-18403.

THE GENERAL RELATIVITY "FORCE" ON A SATELLITE
G. C. McVittie, In; Dynamics of Satellites: Proceedings of the IUTAM Symposium, Edited by Maurice Roy., New York, Academic Press, Inc., 1963, p. 197/201, A64-12671.

Discussion of the motion of an infinitesimal satellite about a spherical Earth, predicted by general relativity, differing from the motion under the Newtonian inverse square law of gravitation. Two examples are given which illustrate the fact that purely radial perturbations can produce oscillations in the value of the sidereal period of a satellite.

DIRECT CONTACT AMONG GALACTIC CIVILIZATIONS BY RELATIVISTIC INTERSTELLAR SPACEFLIGHT
C. Sagan, Planetary and Space Science, vol. 11, May 1963, p. 485/498, 41 refs., A63-17828.

. . . estimate of such civilizations, based on a number of poorly known parameters (such as the probabilities of the origins of life), is 10^6. The most probable distance to the nearest such civilization is several hundred light-years. Interstellar spaceflight at relativistic velocities is found to have several advantages over electromagnetic communications with these communities. Some of the technical problems involved in the construction of starships with relativistic velocities are discussed. . . . It is shown to be a statistical likelihood that Earth was visited by an advanced extraterrestrial civilization at least once during historical times.

A DISCUSSION OF RECENTLY PROPOSED AETHER DRIFT EXPERIMENTS (Correspondence)
P. F. Smith, Proc. IRE, vol. 50, no. 9, Sept. 1962, p. 1999.

GENERATION OF SUB-MILLIMETER RADIATION BY A BUNCHED BEAM OF RELATIVISTIC ELECTRONS
P. A. Szente, Microwave Lab., Stanford U., Calif., Technical rept., M. L. rept. no. 935, July 1962, 126 p., incl. illus., 17 refs., AD 282 146.

THE GENERAL LIMITS OF SPACE TRAVEL
S. von Hoerner, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 144/159, A64-10224.

Examination of the future possibility of interstellar space travel for terrestrians, and of the present possibility of travel from star to star for more advanced extra-terrestrial beings. The definite answer is not that interstellar space travel is absolutely impossible. . . . The conclusion drawn is that space travel, even in the most distant future, will be confined completely to our own planetary system, and a similar conclusion will hold for any other civilization, no matter how advanced it may be. The only means of communication between different civilizations thus seems to be electro-magnetic signals.

ORBITAL MOTION IN THE THEORY OF GENERAL RELATIVITY
J. D. Anderson, et al., AIAA Journal, vol. 1, June 1963, p. 1372/1374, 10 refs., A63-17964.

ON THE FOUNDATIONS OF RELATIVISTICS ENERGY MECHANICS
D. G. B. Edelen, RAND Corp., Santa Monica, Calif., Rept. no. P2703, May 1963, 37 p., AD 408 034.

PROPOSED USE OF EARTH SATELLITE SIGNALS TO MEASURE PROPAGATION VELOCITY OF ELECTROMAGNETIC WAVES
E. F. Florman, Applied Physics Letters, vol. 3, Dec. 1, 1963, p. 193/195, A64-13361.

. . . experiment involves measuring the change in wavelength of the received signal which originates from a fast-moving source. The velocity of man-made satellites would yield a source velocity sufficiently large to carry out this experiment. . . .

ON A CONSEQUENCE OF THE EINSTEIN POSTULATE
C. K. Gordon, Proc. IEEE, vol. 51, no. 7, July 1963, p. 1056/1057.

RELATIVISTIC AND CLASSICAL DOPPLER ELECTRONIC TRACKING ACCURACIES
J. Hoffman, Mitre Corp., Bedford, Mass., 1963, 23 p., AD 407 753.

. . . This study has taken a fundamental look at the doppler effect. Five steps were developed which enable the exact derivation of the doppler equations for any system. Six different configurations of transmitter, receiver, and vehicle were investigated and the results applied to a number of present and future operational doppler systems. It has been determined that for velocity accuracies of a foot per second or better, the second order relativistic or classical equations must be used. The receipt of a zero doppler shift was investigated and it does not necessarily imply zero line of sight velocity.

TEST OF SPECIAL RELATIVITY OR OF THE ISOTROPY OF SPACE BY USE OF INFRARED MASERS
T. S. Jaseja, et al., Phys. Rev., 2nd Series, vol. 133, March 2, 1964, p. A1221/A1225, 11 refs., A64-14959.

The highly monochromatic frequencies of optical or infrared masers allow very sensitive detection of any change in the round-trip optical distance between two reflecting surfaces . . . allows an improved experiment of the Michelson-Morley type, or a very precise examination of the isotropy of space with respect to light propagation . . . Rotation of the table through 90° produced repeatable variations in the frequency difference of about 275 kc/sec, presumably because of magnetostriction in the Invar spacers due to the Earth's magnetic field. . . . there was no relative variation in the maser frequencies associated with orientation of the Earth in space greater than about 3 kc/sec . . . This preliminary version of the experiment is more precise by a factor of about 3 than previous Michelson-Morley experiments. There is reason to hope that improved versions will allow as much as 2 more orders of magnitude in precision, and that similar techniques will also yield considerably improved precision in an experiment of the Kennedy-Thorndike type.

ASTRORELATIVITY
H. G. L. Krause, In: 12th International Astronautical Congress, Proceedings, vol. 1, Washington, D. C., Oct. 1-7, 1961, New York and London, Academic Press, Inc., 1963, p. 131/160, 28 refs., A63-21247.

Extension of the special theory of relativity to include generalized relativistic conservation laws of momentum and total energy for bodies whose proper or rest mass is variable with time—i.e., rockets. . . . A formula for the relative difference of the time rates of a satellite clock, compared against a standard Earth clock (time dilatation effect and red shift), is derived for arbitrary orbits.

SIGNAL PROPAGATION IN A POSITIVE DEFINITE RIEMANNIAN SPACE
C. Lanczos, Phys. Rev., 2nd Series, vol. 134, April 27, 1964, p. B476/B480, 10 refs., A64-17404.

. . . It is shown that a positive definite Riemannian space of fourfold lattic structure is well suited to the propagation of signals, if the components of the metric tensor assume very large values along some narrow ridge surfaces. The resulting signal propagation is strictly translational and has the behavior of a particle which moves at the speed of light. According to this theory, the discrepancy between classical and quantum phenomena is caused by the misinterpretation of a Riemannian metric in Minkowskian terms.

ACCELERATING FRAMES OF REFERENCE AND THE CLOCK PARADOX
H. Lass, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 15/17.

The Lorentz-Einstein transformations are obtained by a method which enables one to derive a coordinate transformation between an inertial frame of reference and a noninertial accelerating system. With the aid of this transformation, one computes the explicit time for the round trip of the noninertial twin who leaves the inertial twin with initial speed -V, and returns by means of an acceleration. It is found that the accelerating twin returns younger than the inertial twin.

ACCELERATING FRAMES OF REFERENCE AND THE CLOCK PARADOX
H. Lass, Amer. J. Phys., vol. 31, no. 4, April 1963, p. 274/276, 6 refs., N63-17709.

KINETIC TREATMENT OF THE STABILITY OF A RELATIVISTIC PARTICLE BEAM PASSING THROUGH A PLASMA
R. C. Mjolsness, Physics of Fluids, vol. 6, Dec. 1963, p. 1730/1740, 10 refs., A64-12231.

Stability analysis of an equilibrium configuration consisting of a uniform particle beam of circular cross section and infinite extent streaming at highly relativistic velocity through a uniform, dense background plasma. . . .

SDVIG CHASTOTY PRE RASSEIANII SVETA V RELIATIVISTSKOI PLASME (Frequency Shift During the Scattering of Light by a Relativistic Plasma) (In Russian)
O. Pogutse, Akademiia Nauk SSSR, Doklady, vol. 153, Nov. 21, 1963, p. 578/589, A64-12322.

. . . light scattering from an isotropic plasma with a Maxwellian distribution function. It is shown that, if relativity is taken into account, the maximum of the scattered light shifts to the high-frequency region. . . .

GENERALISATION DE LA CONDITION DE LORENTZ (Generalization of the Lorentz Condition) (In French)
P. Poincelot, Ann. Telecomm., vol. 18, no. 9-10, Sept./Oct. 1963, p. 174/176.

DIRECT CONTACT AMONG GALACTIC CIVILIZATIONS BY RELATIVISTIC INTERSTELLAR SPACEFLIGHT
C. Sagan, Repr. from Plant Space Sci., vol. 11, 1963, p. 485/498, N63-20930.

GENERATION OF MILLIMETER WAVES BY MEANS OF THE DOPPLER EFFECT
M. D. Sirkis, et al., IEEE Trans. Electron Devices, vol. ED-10, Nov. 1963, p. 417, A64-11706.

Review of an experiment in which the Doppler effect was used to produce radiation by means of a frequency conversion process at 39.7 Gc. An electron beam produced by a relativistic electron bunching accelerator (rebatron) passed through a rectangular cavity in which a TE_{101} field configuration was established by a pumping magnetron in a direction normal to the electric field. . . . A power output of 2.9 mw was calculated from theoretical considerations, and an output of 2.4 mw was measured experimentally.

THE INVESTIGATION OF A SET OF WEAKENED FIELD EQUATIONS FOR GENERAL RELATIVITY
A. H. Thompson, Kings Coll., U. of London, Gt. Brit., Rept. no. TN10, 21 Aug. 1963, 56 p., AD 430 699.

THE INFLUENCE OF THE EARTH'S ORBITAL MOTION ON RADIO MEASUREMENTS OF RANGE AND VELOCITY IN COSMIC SPACE (Translation)
V. M. Vakhnin, Planetary and Space Science, vol. 11, May 1963, p. 561/566, A63-17836.

. . . All Quantities are determined relative to a "solar" coordinate system. A correction for the Lorentz dilation of time is introduced. . . . "terristrial" coordinate system. . . . inaccurate within the range of the Lorentz multiplier. In addition, the introduction of "terrestrial" coordinates involves the assumption that the Earth's motion is retilinear and uniform, which is, in fact, only approximately true, and even then for only short periods of time.

PRECISION TIME OR FREQUENCY TRANSMISSION TO MOVING VEHICLES
R. M. Waetjen, Air Force Cambridge Research Labs., Electronics Research Directorate, Bedford, Mass., Research Report, AFCRL-63-93, April 1963, 21 p., 3 refs., N63-16281.

. . . capable of transmitting the output of an ultrastable oscillator or clock with an extremely high degree of accuracy to a moving vehicle. . . . Applications of the circuit include radio navigation, guidance, and tracking, as well as data transmission, telemetry, and possibly communications involving earth satellites, moon satellites, and interplanetary and other space vehicles.

NONLINEAR STATIONARY WAVES IN RELATIVISTIC PLASMAS
H. S. C. Wang, Physics of Fluids, vol. 6, Aug. 1963, p. 1115/1123, 18 refs., A63-21683.

. . . It is proved here that in plasmas of physically reasonable electron-velocity distributions, stationary waves of arbitrary amplitude can be propagated and obey a disperson equation. . . . if the velocity of wave propagation is greater than c, however, there is no amplitude limitation. . . .

Related Publications:

A PROPOSED TEST FOR THE EXISTENCE OF A LORENTZ-INVARIANT AETHER (Correspondence)
P. M. Rapier, Proc. IRE, vol. 50, Feb. 1962, p. 229/230.

Section 3B.52

3B.520: Plasma Technology

Included: Reviews of plasma physics; Fundamentals of semi-conductor plasma in slow-wave media; Microwave plasma components; Penning discharge, microwave diagnostics of plasmas; Reviews of plasma oscillations; Coherent radiation by plasma oscillation; Harmonic generation in plasmas; Plasma amplifier; Plasma devices.

Not Included: Detailed research results in plasma physics; Theory of plasma oscillations; Plasma discharges.

Cross References: Millimeter wave components (3B.220); Millimeter wave generation (Sect. 3B.23 and 3B.24).

Principal Publications:

CONTEMPORARY PLASMA PHYSICS
L. Gold, IRE Trans. Space Electronics Telem., vol. SET-5, no. 4, Dec. 1959, p. 162/165.

MILLIMETREWAVE NOISE OF A PLASMA
P. A. H. Hart, et al., "Ionization in Gases" Conference Paper, Munich, Abstr. 2102, 1961, p. 492/499.

Measurements of the microwave radiation temperature of a positive column of helium, neon, argon, krypton and xenon are presented. Measurements were performed at a wavelength of 8 mm and some data were obtained at 4 mm. The results are compared with the temperatures measured at 30 mm wavelength.

PLASMAS: CIRCUIT ELEMENTS FOR FUTURE ELECTRONICS?
J. E. Hopson, Space/Aeronautics, vol. 36, no. 2, Aug. 1961, p. 112/117.

A SOURCE AND DETECTOR OF RADIATION IN THE WAVELENGTH REGION 1500-50 ANGSTROMS SUITABLE FOR RADIATION EFFECTS STUDIES ON MATERIALS IN VACUO
H. R. Moore, Electro-Optical Systems, Inc., Pasadena, Calif., Wright-Patterson AFB, Ohio, Aeron. Systems Div., WADD TR 60-371, July 1961, 49 p., 55 refs., N63-19325.

The principle of the radiation source is the repetitive pulsed discharge of a capacitor stored energy into a ceramic discharge tube. A very hot plasma will thus be generated which will emit vacuum ultraviolet radiation by Bremsstrahlung-like processes.

THE SPECTRUM OF ELECTROMAGNETIC WAVES GUIDED BY A PLASMA LAYER
T. Tamir, et al., Microwave Research Inst., Polytechnic Inst. of Brooklyn, N.Y., Research rept. no. PIBMRI-970-61, ARCRL 62-135, 13 Dec. 1961, 53 p., incl. illus., 30 refs., AD 278 127.

PLASMA ENGINEERING—PART II: MEASURING PARAMETERS
M. F. Wolff, Electronics, vol. 34, no. 31, Aug. 1961, p. 33/39.

Electric and magnetic probes, microwaves, photography, and spectroscopy are among the diagnostic tools with which plasmas can be studied . . . Large Bibliography.

IONIZATION OF GASES BY OPTICAL MASER RADIATION
E. K. Damon, et al., Ohio State U. Research Foundation, Antenna Lab., Columbus, Rept. 1083-19, Nov. 30, 1962, 9 p., refs., N63-18288.

Apparent ionization of noble and atmospheric gases in a focused laser beam has been observed. The effect shows a strong nonlinearity and appears to be power dependent rather than energy dependent. The results of preliminary measurements using conventional and Q-switched laser pulses are included.

ELECTROMAGNETIC WAVE PROPAGATION THROUGH A PLASMA: THEORETICAL AND EXPERIMENTAL STUDIES
G. R. Evans (comp.), Lockheed Missiles and Space Co., Sunnyvale, Calif., LMSC SB-61-56; 3-80-61-34, Jan. 1962, 78 p., 173 refs., N63-22352.

. . . Although the compilation includes references on the propagation of any type of electromagnetic wave through a plasma, the primary concern is literature on the influence of a plasma on the propagation of microwaves; i.e., radar and telemetry. The period covered is generally from 1950 to date.

MICROWAVE DIAGNOSTIC TECHNIQUES FOR PLASMA TRANSMISSION AND PLASMA POST IN WAVEGUIDE CONFIGURATIONS
P. D. Goldan, et al., Electrical Engineering Research Lab., U. of Illinois, Urbana, Scientific rept. no. 3, AFCRL 62-587, illus., tables, 43 refs., AD 284 484.

FAST WAVE CYCLOTRON PLASMA AMPLIFIER
E. Langberg, Elcon Lab., Inc., Watertown, Mass., Rept. no. N-10-62-1; Technical note no. 1, 4 Oct. 1962, 25 p., incl. illus., AD 285 611.

NANOSECOND PULSE BREAKDOWN STUDY
L. C. Scholz, Armour Research Foundation, Chicago, Ill., Final rept., 15 May-15 Nov. 1962, Rept. no. ARF-A217-7, RADC TDR 62-616, Dec. 1962, 58 p., 123 refs., AD 401 294.

. . . summary . . . various approaches . . . are compared . . . It is suggested that in general for pressure-time products greater than 1 torr-nanosecond, measurements made under cw conditions will be satisfactory.

GENERATION OF MICROWAVE HARMONICS IN IONIZED GASES
C. B. Swan, Toronto U., Canada, RR 29, Sept. 1962, 166 p., AD 406 840.

. . . Measurements were made with fundamental power in the range 5 to 80 watts. Preliminary experiments at 35 gc were not successful because of RF breakdown at the outside wall of the discharge vessel. . . .

INVESTIGATION OF MODULATIONS ARISING FROM INTERACTION OF ELECTROMAGNETIC WAVES WITH A PLASMA
S. Tetenbaum, et al., General Telephone and Electronics Labs., Inc., Palo Alto, Calif., Rept. for 30 March 1961-31 Oct. 1962, RADC TDR 62-613, 15 Nov. 1962, 118 p., AD 297 479.

PRODUCTION OF MILLIMETER AND SUB-MILLIMETER ELECTROMAGNETIC WAVES BY THE INTERACTION OF PLASMA AND ELECTRON BEAMS WITH HIGH INTENSITY PULSED MAGNETS
R. W. Waniek, Advanced Kinetics, Santa Ana, Calif., Quarterly scientific rept. no. 8, Final, AFCRL-62-718, 15 July 1962, 27 p., 11 refs., AD 401 191.

The attempt to produce the production of coherent millimeter and sub-millimeter electromagnetic radiation at high power levels by the deceleration of charged particles injected into the strong magnetic fields is discussed. Difficulties related to the source-detection problems in this region of the spectrum are treated.

MICROWAVE AMPLIFICATION BY RESONANCE SATURATION
Technical Research Group, Syosset, N.Y., Technical note no. 1, RADC TDR 62-438, 9 Oct. 1962, 25 p., incl. illus., refs., AD 286 917.

Amplification centered about a frequency of 86 kms was attained in gaseous HCN-15 by means of a new principle. The nonlinear properties required for amplification are obtained by microwave power saturation of this gas. A gain of 1.5 db in a travelling wave system was measured. The bandwidth was estimated at 3 mc. The extension of this principle to practical devices at higher frequencies was found to be feasible.

MEASUREMENT OF PLASMA PROPERTIES BY MEANS OF PROBE TECHNIQUES
S. Aisenberg, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 668/691.

Considerable information about local properties and processes in dc and rf plasmas can be obtained by means of probe measurements . . . The problem of multiple probe measurements in electrodeless discharges will be considered along with possible sources of error. A triple probe method developed for use in diagnostic measurements in Laser plasmas will be described. . . .

MICROWAVES AND PLASMAS
A. H. W. Beck, Institution of Electrical Engineers, Journal, vol. 9, Oct. 1963, p. 420/427, 20 refs., A64-11202.

. . . review of experimental and theoretical aspects of the use of gas-discharge or plasma devices to generate microwave oscillations. Recent beam-plasma experiments are reviewed, and experimental studies of plasma amplifiers are considered. . . .

WAVES IN PLASMAS
P. O. Berrett, et al., Utah U. Microwave Devices Lab., Salt Lake, City, In its Microwave Devices Lab., Consolidated Quarterly Rept., March 31, 1963, p. 51/57, 1 ref., N63-18712.

. . . to study plasma wave propagation in waveguide or microwave circuits and the interaction of these waves with electron beams for use as millimeter wave signal generators. . . A few special cases were analyzed by an alternate approach and the results used as checks on the general equation.

HIGH FREQUENCY ELECTRONIC RESEARCH AT THE INSTITUT FUR HOCHFREQUENZTECHNIK ETH, ZURICH SWITZERLAND
F. E. Borgnis, et al., Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1615/1620.

. . . The second topic concerns the generation of large HF electromagnetic fields inside a plasma by applied external fields below the plasma frequency.

MILLIMETER WAVE COMPONENT DEVELOPMENT (BEAM-PLASMA AMPLIFIER)
P. Chorney, Microwave Associates, Inc., Burlington, Mass., RADC TDR 63 477, Dec. 1963, 22 p., AD 427 059, AD 419 455, AD 433 900.

. . . From the theoretical studies it is concluded that highly ionized plasmas are desirable for amplifier applications because of the longer mean-free-paths that exist. Recommendations are made and plans for the forthcoming quarter are outlined . . .

C.V.D. RESEARCH PROJECT RP3-41 ELECTRON BEAM ION PLASMA INTERACTION
P. B. Curtis, et al., General Electric Co., Ltd., Gt. Brit., Annual rept. no. 2, Rept. no. 14 511C, 25 Nov. 1963, 22 p., AD 427 605.

. . . directed towards the study of a plasma traveling wave amplifier . . .

DIAGNOSIS OF PLASMA CYLINDERS BY ANGULAR SCATTERING OF MICROWAVES
R. L. Easley, Army Missile Command, Redstone Arsenal, Huntsville, Ala., AMC Rept. no. RR TR63 14, 1 May 1963, 73 p., AD 419 614.

. . . A 20 kilowatt, dc arc, argon plasma jet formed a cylindrical plasma requiring no containing walls. Angular scattering distributions were measured at 35 and 72 kms. . . . Predicted values for the magnitude and phase of the scattered field were obtained, using an IBM 7090 computer to solve the scattering problem for a homogeneous, infinitely long plasma cylinder having a range of electron densities and collision frequencies. The plasma jet was found to have a rapidly decreasing electron density as a function of radius. . . .

A SLOW-WAVE STRUCTURE AT ULTRA-MICROWAVES (Correspondence)
O. P. Gandhi, Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 372.

A slow-wave mode, employing a gaseous plasma as a propagating medium, can be excited with a steady magnetic field in the direction of wave propagation, and in the frequency range from low values to frequencies on the order of the plasma, and cyclotron frequencies. . . . A semiconductor plasma can, therefore, be used as a slow-wave medium in the ultra-microwave region. . . .

PLASMA GENERATION AND MEASUREMENTS
V. Gilson, et al., Utah U. Microwave Devices Lab., Salt Lake City, In its Microwave Devices Lab., Consolidated Quarterly Rept. March 31, 1963, p. 58/84, 10 refs., N63-18713.

Electron densities that have been determined by Langmuir double probes are compared with those determined by a microwave resonant cavity for a mercury arc discharge . . .

DIFFUZIIA ZARIAZHENNYKH CHASTITS PLAZMY V MAGNITNON POLE
(Diffusion of the Charged Particles of a Plasma in a Magnetic Field) (In Russian)
V. E. Golant, Uspekhi Fizicheskikh Nauk, vol. 79, March 1963, p. 377/440, 130 refs., A63-16842.

. . . A broad literature survey of available experiments . . .

MICROWAVE DIAGNOSTICS OF PLASMAS
R. W. Grow, et al., IEEE Trans. Nuclear Science, vol. NS-11, Jan. 1964, p. 277/283, 7 refs., A64-14511.

Formulation of the theory of wave propagation in plasma media where temperature and collision effects are important by combining the wave equation and Boltzmann's equation for average electron velocity. . . .

BEAM-GENERATED BEAM-PLASMA SYSTEM
J. E. Hopson, J. Appl. Phys., vol. 34, Aug. 1963, p. 2425/2429, A63-20458.

Investigation of a plasma generated by passing a magnetically focused cylindrical electron beam through a neutral gas. . . . a certain minimum critical pressure is required for the beam to generate a plasma . . . increased plasma density is associated with the generation of microwave noise.

AN INVESTIGATION OF PLASMA EM RADIATION INTERACTION
S. Katz, et al., Aeronutronic, Newport Beach, Calif., AFSWC TDR 62 131, Final rept., April 1963, 251 p., AD 411 260.

. . . nonequilibrium behavior of an ionized gas whose constituent particles interact through the Coulomb potential and through the transverse modes of the electromagnetic field. The Bogoliubov approach . . . was applied . . . The diagram method of Prigogine and Balescu was applied to the full system Hamiltonian . . .

A SURVEY OF OPTICAL INTERFEROMETRY AS APPLIED TO PLASMA DIAGNOSTICS
A. F. Klein, Northwestern University, and AIAA, Biennial Gas Dynamics Symposium, 5th, Physico-Chemical Diagnostics of Plasmas, Evanston, Ill., Aug. 14-16, 1963, Paper 63-377, 12 p., 17 refs., A63-21639.

. . . principles and techniques involved in the application of optical interferometry to plasma studies. . . . Experiments to date in the field are reviewed, and recent experiments are described in which monochromatic interferograms about two-dimensional, sharp and blunted bodies have been obtained using an image converter camera and an exploding-wire light source. Resolution times down to 20 nanosec have been obtained while maintaining a conventional field of view. . . .

INSTABILITY OF PLASMA SHEATH ROTATION AND ASSOCIATED MICROWAVE GENERATION IN A PENNING DISCHARGE
W. Knauer, et al., Applied Physics Letters, vol. 3, Oct. 1, 1963, p. 111/112, A64-13369.

. . . instability of a rapidly rotating plasma sheath near the anode of a low-pressure Penning discharge that generated intense microwave noise radiation in a split anode configuration. The RF energy was extracted from the anode halves through short leads and dissipated in an ohmic load. . . .

MICROWAVE RADIATION FROM A PLASMA IN A MAGNETIC FIELD II
H. Kubo, et al., J. Phys. Soc., Japan, vol. 19, Feb. 1964, p. 221/226, 10 refs., A64-16259.

. . . The experimental results indicate that the resonant radiations of the ordinary wave, propagating perpendicularly to a magnetic field, were observed near the electron cyclotron harmonics. The number of successive harmonics increased with decreasing gas pressure, regardless of the type of gas used. . . . it has not been discussed whether the resonant radiations of successive harmonics for the ordinary wave have Landau damping or not. On the contrary, there is no Landau damping for such radiations for the extraordinary wave, as pointed out by Bernstein.

STUDY OF TECHNIQUES FOR A HIGH POWER FAST WAVE PLASMA CYCLOTRON AMPLIFIER
E. Langberg, et al., Elcon Lab., Inc., Watertown, Mass., Final rept., May 1962-June 1963, ASD TDR 63 733, 11 Dec. 1963, 98 p., AD 429 146.

. . . concerned with the phenomena of microwave plasma gain in the vicinity of cyclotron resonance. . . .

TRANSMISSION OF A SIGNAL BETWEEN TWO HIGH-FREQUENCY PROBES IN A PLASMA (Translation)
S. M. Levitskii, et al., Soviet Physics—Technical Physics, vol. 8, Oct. 1963, p. 319/324, A63-21473.

MICROWAVE PROPAGATION THROUGH A PLASMA IN A MAGNETIC FIELD
D. W. Mahaffey, Phys. Rev., vol. 129, no. 4, Feb. 1963, p. 1481/1488.

Experiments were performed on the propagation of X-band . . . microwave signals through a plasma in a magnetic field ($\approx$ 4 kG). The direction of propagation was parallel to the magnetic field lines. The regions of transmission and attenuation for both right-hand and left-hand circularly polarized microwave signals were located, at frequencies above and below both the electron cyclotron frequency and the electron plasma frequency. . . .

MICROWAVE RADIATION FROM A PLASMA IN A MAGNETIC FIELD. I
K. Mitani, et al., J. Phys. Soc., Japan, vol. 19, Feb. 1964, p. 211/220, 15 refs., A64-16258.

Investigation of microwave radiations from a dc discharge plasma in a magnetic field. . . .

MICROWAVE PLASMA COMPONENTS STUDY
A. Olte, et al., Michigan Univ., Ann Arbor, RADC TDR 64 94, March 1964, 29 p., AD 436 642, AD 428 908, AD 424 721, AD 409 596.

. . . development of a first order theory for the transmission characteristics of a magnetoplasma resonance isolator employing the TM11 mode in a rectangular waveguide . . .

THE APPLICATION OF THE FOCUSED FABRY-PEROT RESONATOR TO PLASMA DIAGNOSTICS
R. I. Primich, et al., GM Defense Research Labs., Santa Barbara, Calif., Rept. no. TM 63 210, Aug. 1963, AD 417 636.

FUNDAMENTAL CONCEPTS, TECHNIQUES, AND APPARATUS FOR THE MEASUREMENT OF GAS PROPAGATION CHARACTERISTICS AT HIGH MICROWAVE POWERS, CHAPTER 1
E. Rolfe, et al., Raytheon Co., Wayland, Mass., Advanced Development Lab., Scientific Rept. no. 2, In its: Investigation of Microwave Coupling and Energy Partition and Transport within a Plasma, vol. 1, Feb. 1963, 308 p., refs., N64-14219.

. . . describes the theoretical and experimental research program concerned with plasmas, particularly with the mechanisms of high-power microwave energy absorption and thermal energy transfer in a gas, the consequent heating of the un-ionized components of the gas, and the deionization and energy loss mechanisms involved. A detailed theoretical analysis of physical mechanisms governing the absorption of microwave radiation in gaseous plasmas and two different methods of treatment used in the analysis of plasma behavior are discussed.

INVESTIGATION OF MICROWAVE COUPLING AND ENERGY PARTITION AND TRANSPORT WITHIN A PLASMA. VOLUME 2. CHAPTER 2: THE MEASUREMENT OF THREE-BODY ELECTRON-ION RECOMBINATION IN A DENSE PLASMA
E. Rolfe, Raytheon Co., Wayland, Mass., Final rept., Scientific rept. no. 3, AFCRL 63 119, vol. 2, Feb. 1963, 1 v., AD 421 592.

. . . experimental study of three-body recombination in a dense plasma of Helium with a trace addition of Argon is reported. . . . The experimental results are compared with the criteria of Gray and Kerr for distinguishing electron loss by recombination from loss by diffusion.

AN AUTOMATIC SYSTEM FOR MEASURING PLASMA PARAMETERS
W. E. Scharfman, Stanford Research Inst., Menlo Park, Calif., TR 76, May 1963, 16 p., AFCRL 63 155, AD 408 418.

An inexpensive system for automatic measurement of microwave phase shift is described . . .

PLASMA AND ITS APPLICATIONS (In French)
E. Schatzman, Onde Electr., vol. 43, no. 436/7, July/Aug. 1963, p. 748/751.

The properties if ionised gases are beginning to be well understood and are of an astonishing diversity. The aim of this article is to investigate the basic principles which govern the use of plasma in various applications: energy conversion, generation of movement, production of order out of disorder, wave propagation and microscopic phenomena.

PLASMA DIAGNOSTICS WITH SHORT ELECTROMAGNETIC PULSES
H. J. Schmitt, IEEE Trans. Nuclear Science, vol. NS-11, Jan. 1964, p. 125/136, 9 refs., A64-14495.

. . . propagation of short electromagnetic pulses in an ionized region . . . The transient oscillations show a periodicity which is directly related to the plasma frequency and are useful for nearly instantaneous plasma diagnostics. . . .

AMPLIFICATION BY RESONANCE SATURATION IN MILLIMETER WAVE CAVITIES
B. Senitzky, et al., Technical Research Group, Syosset, N.Y., Tech. note no. 3, RADC TDR 63 254, 23 May 1963, 23 p., AD 411 995.

A resonant cavity filled with HC12N14 gas was used to obtain amplification of electromagnetic radiation of 3.4 mm wavelength. . . . Under certain conditions, the non-linear properties of the gaseous medium can be used to yield a stable information signal gain of 20 db.

MM-WAVE AMPLIFICATION BY RESONANCE SATURATION IN GASES
B. Senitzky, Technical Research Group, Syosset, N.Y., Final rept., RADC TDR 63 562, March 1964, 112 p., AD 434 764.

The power-saturated resonance absorption of a gas has been used to achieve mm-wave amplification. Experiments were conducted at room temperature in both a traveling wave system and in a resonant cavity. The results are in good agreement with theory. A gain of 20 dB was obtained with a 6 inch long, 3/4 inch-diameter cylindrical cavity at 86 Gc. . . .

HARMONIC GENERATION IN PLASMAS
F. J. Sforza, RADC, Griffiss Air Force Base, N.Y., Final rept., RADC TDR 63 288, AD 412 952.

. . . Measurements on the variation of the generated second harmonic power with the incident X/band power . . . Experimental data on the reflected X-band power as a function of the incident power are shown and compared with theoretical predictions.

STUDY OF THE GENERATION OF COHERENT ELECTROMAGNETIC RADIATION BY A PULSING PLASMA
R. E. Skinner, RCA Defense Electronic Products, Camden, N.J., Final rept., RADC TDR 63 135, Feb. 1963, 78 p., AD 404 539.

Coherent radiation from a plasma stimulated by a modulated electron beam at frequencies above the hybrid frequency was observed, with electronic gains of more than 20 db. The measurements were made in the 3.95- to 5.85-gc region.

COHERENT RADIATION BY PLASMA OSCILLATIONS
R. E. Skinner, et al., Physics of Fluids, vol. 7, Jan. 1964, p. 148/150, A64-14291.

Evaluation of a statement by Kino and Allen, suggesting that in a finite electron beam and a finite plasma configuration one might expect coupling between longitudinal oscillations on the beam and electromagnetic wave traveling normal to the beam. An experimental study of such radiation by plasma oscillations is made. . . . Measurements were carried out by introducing a signal on the input coupler and measuring the signal at the output coupler and at the microwave horn. There was no significant change in the signal level present at the output coupler when the plasma was introduced. The net transmitted gain ranged between -10 to + 10 db. On the other hand, there was a significant change, at isolated frequencies, in the ratio of the radiated signal to the signal on the output coupler.

ELECTRON BEAM PLASMA SUBMILLIMETER GENERATION
G. A. Swartz, RCA Labs. Div.,Radio Corp. of America, Princeton, N.J., Interim engineering rept. no. 1, 1 April-31 July 1963, Aug. 1963, 23 p., AD 420 979.

A stable cesium plasma . . . (plasma frequency, 300 kMc) and 50% ionization was produced by a modified Penning arc. The hot anode cylinder is shown to be a significant factor in the achievement of the very dense highly ionized plasma. . . .

NEW MILLIMETER WAVE DEVICE—BEAM-PLASMA AMPLIFIER
G. A. Swartz, Electronics, vol. 36, Nov. 8, 1963, p. 40/42, A64-11356.

. . . new amplifying technique for millimeter and submillimeter wave, using a high-current-density electron beam directed into a cesium plasma. The advantages of the beam-plasma amplifier over the TWT tube are briefly considered. The device, when perfected, could supply tens of watts at up to 100,000 Gc. A schematic diagram of a 23-Gc beam-plasma amplifier recently tested is presented.

GENERAL RESEARCH. FREQUENCY SPECTRUM OF THERMAL FLUCTUATIONS IN PLASMAS
E. C. Taylor, et al., Aerospace Corp., Los Angeles, Calif., Rept. no. ATN63 9226 4, 9 Sept. 1963, 23 p., AD 416 745.

The frequency spectrum of electron density fluctuations arising from thermal motions of the particles in a plasma is computed by means of an extension of Richardson's noise theory . . .

INVESTIGATION OF MODULATIONS ARISING FROM INTERACTION OF ELECTROMAGNETIC WAVES WITH A PLASMA
S. Tetenbaum, et al., General Telephone and Electronics Labs., Inc., Palo Alto, Calif., Final rept., RADC TDR 63 213, 15 April 1963, 130 p., AD 411 571.

. . . generation of second harmonic and sum and difference frequencies for low-level incident signals at X- and K-bands . . .

NONLINEAR STATIONARY WAVES IN RELATIVISTIC PLASMAS
H. S. C. Wang, Physics of Fluids, vol. 6, Aug. 1963, p. 1115/1123, 18 refs., A63-21683.

. . . It is proved here that in plasmas of physically reasonable electron-velocity distributions, stationary waves of arbitrary amplitude can be propagated and obey a dispersion equation. . . . if the velocity of wave propagation is greater than c, however, there is no amplitude limitation. . . .

FREQUENCY RANGES FOR EXISTENCE OF WAVES IN A COLD, COLLISIONLESS HYDROGEN PLASMA
R. R. Woollett, National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio, Washington, NASA, April 1964, 31 p., refs., N64-18737.

. . . The existence regions are determined for a range of magnetic fields from 10^2 to 10^5 gauss, a range of ion densities from 10^{10} to 10^{14} ions per cubic centimeter, and a range of selected axial wavelengths from 10 to 100 centimeters. The computations are compared with those resulting from an approximate dispersion relation that neglects the effects of electron inertia . . .

INVESTIGATION OF MICROWAVE COUPLING AND ENERGY PARTITION AND TRANSPORT WITHIN A PLASMA. VOLUME I
Raytheon Co., Wayland, Mass., Final rept., Scientific rept. no. 2, AFCRL 63 199, vol. 1, June 1963, 1 vol., AD 421 591.

. . . Theoretical Analysis of Gaseous Plasmas and Important Phenomena at Microwave Frequencies . . . The absorption and reflection of microwave radiation by ionized gases . . . Interaction of electromagnetic waves with a reentry body plasma sheath; Wave Propagation Through a Plasma-Filled Waveguide Section; The application of Langmuir probes to the measurement of electron density . . .

PLASMA SPECTROSCOPY, ANNOTATED BIBLIOGRAPHY
Aerospace Information Div., Washington, D. C., AID B63 93, 8 July 1963, 40 p., AD 414 327.

INVESTIGATION OF NEW CONCEPTS FOR MICROWAVE POWER GENERATION (PLASMA STUDIES)
Cornell U. School of Electrical Engineering, Ithaca, N.Y., Final rept., RADC TDR63 465, vol. 1, Dec. 1963, 1 vol., AD 427 003.

. . . design and construction, and preliminary experimental results, of a test vehicle for studying plasma electron beam interaction are described . . .

Related Publications:

ELECTROMAGNETIC WAVE PROPAGATION THROUGH MAGNETO-ACTIVE PLASMAS
R. Mason, et al., Aerospace Corp., Los Angeles, Calif., Rept. no. TDR 69 2119TR3, 1 Feb. 1962, 122 p., AD 413 418.

Section 3B.53

3B.530: New Electromagnetic Frequency Ranges

Included: Gamma radiation in space communications; Mossbauer effect; Induced gamma ray emission; X-ray devices for potential communications applications; Intermediate wave range (microwave to IR) and its use for space communications; Cerenkov radiation; Phreatron effect.

Not Included: Gamma ray physics; X-ray physics.

Cross References: Infrared communications systems (3B.472); Submillimeter wave technology (Div. 3B.2).

Principal Publications:

THE BAND BETWEEN MICROWAVE AND INFRARED REGIONS
I. Kaufman, Proc. IRE, vol. 47, March 1959, p. 381/396.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
P. Kusch, Columbia Radiation Lab., New York, Quarterly progress rept. no. 1, 16 Dec. 1959 - 15 March 1960, Rept. no. CU-3-60 SC-78330, AD 236 966.

Cerenkov radiation in the K-band range was observed in a system that has recently been under design and study. . . . An M-band maser radiotelescope is in advanced stage of design and construction and details of the system are described. . . . Progress in the design of a maser to operate at the frequency of the hyperfine structure line of atomic hydrogen is reported. Studies directed to the achievement of maser action at infra-red frequencies are continuing. . . . Work on a variety of studies of atomic hyperfine structures by several techniques is reported.

AN ANALYSIS OF COSMIC NOISE IN X-RAY COMMUNICATION SYSTEMS
C. A. Ziegler, et al., Tracerlab, Inc., Waltham, Mass., Rept. G-471, RADC TN 61-87, 20 April 1960, 69 p., AD 257 827.

. . . part of a broader investigation of the feasibility of an x-ray space communication system . . . magnitude of environmental background radiation in regions of space that are of interest. Three topics are discussed in detail (1) cosmic rays, (2) geomagnetically trapped corpusicuar radiation, and (3) radiation from the sun. Fach of these topics is divided into two parts; the first part provides a brief review of basic facts and theory, while the second part considers the topic in the context of x-ray space communication.

SUBMILLIMETER WAVE MASER
J. L. Altman, Lab. for Electronics, Boston, Mass., Rept. for Oct. 1959 - Oct. 1961 on Radiation Weapons for Aero-space Vehicles. Dec. 1961, p. 18, AD 272 231.

An unsuccessful attempt to generate submillimeter waves (600 micron wavelengths) by Maser action, using sodium vapor as the medium, D2 sodium line as the pump frequency, and a quartz tube as a resonator is reported . . . Possible reasons for failure are examined.

THE UTILIZATION OF X-RADIATION AS A COMMUNICATIONS MEDUIM IN OUTER SPACE
J. Brinkerhoff, et al., Tracerlab. Inc., Waltham, Mass., RADC TR 61-219, 23 June 1961, 10 p., AD 264 907.

. . . include: (1) the question of proper selection of x-ray energy in relation to the expected background radiation in outer space. (2) means of generation of the x-radiation, (3) means for its detection, and (4) the conditions for modulation and demodulation which would permit the most rapid and reliable transmission of information.

STATISTICAL CONSIDERATIONS APPLICABLE TO COMMUNICATION SYSTEMS UTILIZING DISCRETE QUANTA
J. M. Brinkerhoff, Tracerlab. Inc., Waltham, Mass., RADC TN 61-155, Aug. 1961, 14 p., AD 265 020.

. . . conditions for optimum signal reception are considered. It is shown that the optimum receiver will display various weighted running averages of the number of counts received. A discussion of the statistical effects of x-ray coherence phenomena is appended, and these are seen to have a negligible influence on the behavior of any realistically envisioned x-ray communications system.

FUTURE ASTRO-COMMUNICATION TECHNIQUES. CERENKOV RADIATORS
J. M. Brumbaugh, et al., RCA Defense Electronic Products, Camden, N. J., RADC TN 61-24, March 1961, AD 252 911.

. . . Literature covering experimental and theoretical investigations of Cerenkov radiation in solids and theoretical investigations of Cerenkov radiation in plasmas was re-examined and the results are evaluated. Field expressions for an electron moving through plasma were derived and the conditions for Cerenkov radiation in some limiting cases are discussed. Some estimates of microwave power outputs from radiation in solids are made and experiments are designed to measure this power output. The concept of a regenerative Cerenkov radiation structure is developed.

ELECTRON DEVICES FOR THE MILLIMETER INFRARED GAP
P. D. Coleman, IRE Internat. Conv. Rec., vol. 3, March 1961, p. 54/63.

SPACE COMMUNICATIONS WITH GAMMA RADIATION
J. W. Eerkens, Conv. Rec. Nat. Symp. Global Commun., May 1961, p. 14-17.

MEGAVOLT ELECTRONICS, SUB-MILLIMETER WAVE RESEARCH
J. R. Baird, et al., Electrical Engineering Research Lab., U. of Illinois, Urbana, Annual rept. no. 3, 1 Dec. 1961 - 31 Aug. 1962, Technical note no. 6, ASD TDR 62-1032, 1 Dec. 1962, p. 39, incl. illus., 9 refs., AD 293 827.

. . . Beam coupling sutdies which are described are based upon these effects: (1) Cerenkov interaction in a plasma, (2) Cerenkov interaction in a ferrite, and (3) transition radiation. . . .

FUTURE ASTRO-COMMUNICATION TECHNIQUES
J. M. Brumbaugh, et al., RCA Defense Electronic Products, Camden, N. J., Final rept., March 1961 - Oct. 1962, RADC TDR 62-524, Oct. 1962, p. 46, incl. illus., 25 refs., AD 292 966.

theoretical analysis of Cerenkov power generation for various beam geometries . . . general analysis of the Cerenkov effect and its relation to the Roentgen current. . . .

SPANNING THE MICROWAVE INFRARED GAP
P. D. Coleman, Proc. IRE, vol. 50, May 1962, p. 1219/1224.

. . . Brief historical accounts are given of past work leading up to the submillimeter wave frontier. . . .

CERENKOV RADIATION AND ITS APPLICATION TO MICROWAVE GENERATION
R. J. Kenyon, Rome Air Development Center, Griffiss AFB, N. Y., RADC RAU TM62 7, Dec. 1962, 10 p., AD 403 527.

. . . presently being explored as a technique for establishing a high efficiency high power rf device operatable in the 2 to 10 kmc region . . .

CERENKOV RADIATION AS LEAKY SURFACE WAVES (Correspondence)
L. W. Zelby, Proc. IRE, vol. 50, no. 10, Oct. 1962, p. 2134/2135.

STUDY AND INVESTIGATION OF MILLIMETER AND SUB-MILLIMETER RECEIVER TECHNIQUES
Electrical Engineering Research Lab., U. of Illinois, Urbana, Technical documentary rept. no. 1, 1 March 1961 - 28 Feb. 1962, RADC 62-313, 1 June 1962, 43 p., incl. illus., table, 32 refs., AD 284 905.

. . . usable in the millimeter-infrared region . . . analysis and evaluation of pyroelectric effect detectors . . . Hall effect devices, photodetection schemes, electron heating in intrinsic semiconductors, and superconducting devices. A goubau beam type waveguide with a design frequency of 75 kmc was constructed for use in evaluating detection schemes. . . . (See also AD 284 562.)

MICROWAVE AND OPTICAL MASERS FOR MM WAVES
A. Akselrad, et al., David Sarnoff Research Center, Princeton, N.J., Rept. no. 4 (Final), 1 Nov. 1962 - 31 Oct. 1963, 20 Dec. 1963, 44 p., AD 432 058.

. . . study of far-infrared maser materials . . . Two gas maser cells were constructed suitable for operation in the 3-micron to 300 micron range. . . .

MICROWAVE AND OPTICAL MASERS FOR MM WAVES
C. H. Anderson, et al., David Sarnoff Research Center, Princeton, N. J., Quarterly rept. no. 3, 1 May - 31 July 1963, 31 July 1963, 12 p., AD 424 690.

Instrumentation for the study of possible far-infrared (5 microns - 1000 microns) coherent radiation generators was continued . . . Initial experiments were carried out to observe optically pumped microwave maser operation . . .

INDUCED GAMMA-RAY EMISSION (Correspondence)
G. C. Baldwin, et al., Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1247/1248.

The communication "Induced γ -Ray Emission" by Vali and Vali is of considerable interest . . . This communication will be concerned primarily with differences between their work and ours; a full report of our work is being prepared for publication elsewhere. . . .

EXTREMELY HIGH FREQUENCY MASER AMPLIFIER STUDY PROGRAM
R. L. Bell, et al., Varian Associates, Palo Alto, Calif., Interim engineering rept. no. 6, 16 Sept. - 15 Dec. 1963, Rept. no. 301 6Q, 15 Dec. 1963, 21 p., AD 428 740.

. . . wide band tunable maser action in the far infrared . . . (See also AD 408 654.)

MILLIMETER ELECTROMAGNETIC RADIATION PRODUCED BY HIGH ENERGY ELECTRON BEAMS
E. Brannen, Western Ontario U. (Canada), Final rept., 1 Nov. 1961 - 31 Jan. 1963, AFOSR 64 0271, 31 Jan. 1963, 9 p., AD 431 119.

. . . generation of millimeter and submillimeter waves with bunched megavolt electron beams, through the interaction with Cerenkov and transition radiators. . . .

MAGNETO-GAS DYNAMIC ANALOG OF CERENKOV RADIATION. I, II.
A. Cantor, et al., IEEE Trans. Nuclear Science, vol. NS-11, Jan. 1964, p. 202/220, A64-14503.

Study consisting of the general electrodynamic formulation of the excitation problem that results from the elimination of the non-electromagnetic properties of the plasma in favor of the electrodynamical response functions - namely, the frequency and wave-number-dependent susceptibility and conductivity tensors. . . .

CERENKOV RADIATION EMITTED BY CHARGED PARTICLES MOVING IN A CIRCLE OF SCREENED WAVE GUIDES WITH A RECTANGULAR CROSS SECTION
A. N. Didenko, Soviet Physics - Technical Physics, vol. 8, Dec. 1963, p. 547/549, A64-10143.

SPACE COMMUNICATIONS WITH GAMMA RADIATION
J. W. Eerkens, In: 12th International Astronautical Congress, Proceedings, vol. 2, Washington, D. C., Oct. 1-7, 1961, New York and London, Academic Press, Inc., 1963, p. 741/748, A63-21289.

Survey of the possiblities and limitations of space communications by gamma rays. . . . limited to outer space, due to the fact that gammas are heavily scattered and absorbed in the atmosphere. However, for communication between satellites or between a Moon station and a satellite, gamma rays may provide a valuable additional link.

A NEW SOLID-STATE X-RAY IMAGE CONVERTER (Correspondence)
T. Kohashi, Proc. IEEE, vol. 51, no. 12, Dec. 1963, p. 1794/1795.

. . . The converter plate has a sandwich-like multilayer structure that is made of a thin flat CdS photoconductive layer with parallel fine-grid electrode held between the ZnS green electroluminescent layer and the transparent di-electric layer with transparent SnO electrode. . . .

K VOPROSU O CHERENKOVSKOM POGLOSHCHENII ELEKTRO-MAGNITNOGO IZLUCHENIIA (Cerenkov Absorption of Electromagnetic Radiation) (In Russian)
A. B. Kukanov, Optika i Spektroskopiia, vol. 15, July 1963, p. 123/124, A63-23488.

Discussion of the acceleration of electrons due to the difference in the energy produced and lost in the Cerenkov effect. . . .

VELOCITY MEASUREMENTS WITH MOSSBAUER EFFECT
R. B. Matthews, et al., Rec. Nat. Space Electronics Symp., no. 5.5, 1963.

. . . In 1958, Rudolph Mossbauer discovered a method of producing monochromatic gamma radiation by binding source nuclei in a crystal structure so that a virtually recoilless emission results. . . . The initial discovery and many experiments since 1958 have provided a wealth of knowledge about this effect. . . .

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia Radiation Lab., New York, Quarterly prog. rept. no. 4, 16 Sept. - 15 Dec. 1963, Rept. no. CU12 63, 15 Dec. 1963, 77 p., AD 430 797.

Direct evidence was obtained for the two-photon decay of the metastable state of the helium ion. . . . Double-resonance and level-crossing studies of the excited states of the chromium atom are continuing. . . . Partial success was achieved in the fabrication of optical double-resonance cells for chemically reactive elements such as calcium. Theoretical studies are continuing on laser quenching of metastable atoms. Further results were obtained on the motional broadening of Rayleigh scattered light. . . . Studies of the microwave properties of model planetary atmospheres are continuing and a model of the Venusian atmosphere was constructed which is consistent with all available data. (See also AD 415 164.)

CERENKOV RADIATION AND LEAKY WAVES (Correspondence)
I. Palocz, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 622/624.

MULTIPLE QUANTUM EFFECTS AT MILLIMETER WAVELENGTHS
R. H. Pantell, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 317-324, 20 refs., A64-11519.

. . . Two methods of generating submillimeter radiation starting with optical signals are also discussed.

MILLIMETER WAVELENGTH POWER GENERATION UTLIZING THE PHREATRON EFFECT
M. D. Petroff, National Engineering Science Co., Pasadena, Calif., Quarterly progress rept. no. 2, 1 Sept. - 1 Dec. 1963, Dec. 1963, 1 v., AD 431 293.

. . . The first experimental results on beam transmission of the device are consistent with the analysis. Stable beam transmission at a current of 60 mA through the two Cerenkov couplers held at 130 kV was maintained at a duty cycle of .8%. . . . Initial unsuccessful attempts at observing bunching of the beam by illumination of the first Cerenkov coupler with 100 kMc power emitted by a co-axial horn are described and evaluated. . . . (See also AD 424 091.)

THE DETECTION OF SUB-mm RADIATION
E. H. Putley, Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1412/1423.

The characteristics of an ideal detector are discussed and are compared with the practical results achieved with the following types of detectors; superheterodyne and video receivers using point-contact rectifiers; InSb photoconductive detectors, both wideband and tunable; thermal detectors, including the Golay cell, and carbon, germanium and superconducting tin bolometers. . . .

CERENKOV RADIATION IN ANISOTROPIC FERRITES
F. J. Rosenbaum, et al., IEEE Trans. Microwave Theory Techniques, vol. MTT-11, Sept. 1963, p. 302/311, 17 refs., A64-11517.

. . . The conditions for Cerenkov radiation in the ferrite are derived from consideration of plane-wave propagation through the ferrite. X-band output powers of approximately one watt were observed using an 0.88-mev bunched electron-beam with a peak current of 18 ma. . . .

CERENKOV RADIATION FROM ANISOTROPIC FERRITES
F. J. Rosenbaum, Electrical Engineering Research Lab., U. of Illinois, Urbana, ASD TDR63 557, 1 May 1963, 109 p., AD 411 504.

. . . generated by a spatially bunched, extended electron-beam passing through an anisotropic ferrite. . .

COMMENT ON "CERENKOV RADIATION AS LEAKY SURFACE WAVES" (Correspondence)
S. N. Samaddar, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 622.

GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS
Y. Ta, Compagnie Generale de Telegraphie, Sans Fil (France), Rept. no. W R1112, TNL, RADC TDR64 29, 31 Oct. 1963, 4 p., AD 428 576.

High frequency waves over the range of 541-612 Gc/s have been obtained by a recent C. S. F. mm carcinotron at the milliwatt level.

INDUCED γ -RAY EMISSION
V. Vali, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 182/184.

The extension of optical maser techniques to the γ -ray region is considered. It is shown that under certain conditions induced γ rays can be produced. The condition of criticality rather than that of oscillation is used because a γ -ray maser does not have a resonant structure. The main observable effects are the shortening of lifetimes of some γ excitations and the appearance of two or more coherent γ quanta. . . .

SUBMILLIMETER RADIATION FROM RELATIVISTIC ELECTRONS
Alabama U., University, Final technical rept., 3 May 1963, 6 p., AD 407 120.

A method for utiliaztion of a bunched relativistic electron beam for production of such radiations at submillimeter wavelengths is reported. Cold radio-frequency tests have been made on structures scaled to C-band, and the results have been compared with theory. A structure scaled to 7.5 mm wavelength has been designed and is being electroformed.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
Columbia Radiation Lab., New York, Quarterly progress rept. no. 2, Rept. no. CU6 63, 16 March - 15 June 1963, 15 June 1963, 66 p., AD 413 976.

The nuclear spin and magnetic moment of 55 hour Cd-115 have been determined by optical double resonance. . . .

Related Publications:

THREE-LEVEL MASER DETECTOR FOR ULTRA-MICROWAVES
K. Shimoda, J. Phys. Soc. Japan, vol. 14, no. 7, July 1959, p. 966.

It is proposed to use a three-level system with the smaller energy spacing corresponding to centimetre waves and the larger spacing to sub-millimetre waves. The incidence of sub-millimetre waves would change the population in one level that affects the absorption of centimetre waves. . . . could be used as a detector for the sub-millimetre waves. A sensitivity of 3×10^{-10} W is calculated for a possible case.

MILLIMETER WAVE TRANSITIONS FOR FREQUENCY CONTROL
F. Barnes, et al., Colorado U., Boulder, Quarterly rept. no. 2, 11 Sept. - 10 Dec. 1963, 10 Dec. 1963, 91 p., AD 432 992.

. . . to investigate molecular transitions in the region above 100kMc to see if it is feasible to develop a frequency standard which can be expected to have a greater precision than the Cs beam machines currently in use. . . .

MICROWAVE AND OPTICAL MASERS FOR MM WAVES
Z. J. Kiss, David Sarnoff Research Center, Princeton, N. J., Quarterly rept. no. 2, 1 Feb. - 30 April 1963, 30 April 1963, 15 p., AD 414 703.

Instrumentation for the study of possible far infrared (5 micron - 1000 micron) coherent radiation generators was continued. . . .

NONLINEAR QUANTUM EFFECTS
R. G. Smith, Microwave Lab., Stanford U., Calif., April 1963, 164 p., AD 405 521.

. . . to study the . . . interaction of more than a single quantum of radiation with an atomic system . . . From the results . . . concluded that a quantum mechanical system possesses non-linear as well as linear properties and that these nonlinear properties may find applications especially in the submillimeter and optical regions where suitable nonlinear elements do not presently exist.

RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVE LENGTHS
Ohio State U. Research Foundation, Columbus, Rept. 1093-18, Annual Summary Report, 1 March 1962, 31 Aug. 1963, 1 Sept. 1963, 13 p., refs., N64-11104.

. . . conventional and nonconventional . . . A submillimeter radiometer was developed . . . use of a carbon bolometer as a detector . . . measurement of the submillimeter properties of maser crystals.

Section 3B.54:

3B.540: Gravitational Fields and Waves

Included: Gravitational waves; Measurement of gravity; Gravity anomalies; Antigravitation; Reviews of quantum theory of gravitation; Characteristics of the Earth's gravitational field; Gravitational machines; Gravimeters; Gravitational radiation; Material waves; Principle of equivalence.

Not Included: Theoretical physics; Theory of gravitation in detail.

Cross References: Plasma technology (3B.520).

Principal Publications:

SOME PROPERTIES OF THE GRAVITATION FIELD AND THEIR POSSIBLE APPLICATION TO SPACE NAVIGATION
J.C. Crowley, et al., IRE Trans. Space Electronics Telem., vol. SET-5, no. 1, March 1959, p. 47/54.

THE ODD HARMONICS OF THE EARTH'S GRAVITATIONAL FIELD
H.F. Michielsen, In: Advances in the Astronautical Sciences, vol. VIII, New York, Plenum Press, Inc., 1963, p. 250/271, 11 refs., A63-17640.

Presentation of expressions for all long-period variations in the orbit elements of a near-Earth satellite, due to zonal gravitational anomalies. Included are the effects of four even and four odd harmonics (up to order 9). A qualitative discussion of these expressions follows, particularly with a view toward the determination of coefficients for the zonal harmonics from satellite observations.

ON THE PROPAGATION AND DECAY OF GRAVITATIONAL WAVES
T.Y. Thomas, Indiana Univ., Bloomington, Ind., 1961, 21 p., AD 435 960.

SOME IMPROVEMENTS IN THE GAK-ZM GRAVIMETER
M.E. Abel'skii, Joint Publications Research Service, New York, JPRS: 16197, 15 Nov. 1962, 8 p., AD 299 168.

LIGHT AND GRAVITATION (Correspondence)
C.W. Carnahan, Proc. IRE, vol. 50, no. 8, Aug. 1962, p. 1826.

The frequency shift experienced by photons in falling through a gravitational field . . .

ON THE ROLE OF GRAVITATIONAL FIELDS IN SOME ELEMENTARY PARTICLE PROCESSES
L. Halpern, Institute of Field Physics, U. of North Carolina, Chapel Hill, 26 March 1962, 31 p., AD 408 007.

THE MEASUREMENT OF GRAVITY
J.C. Harrison, Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2302/2312.

Absolute measurements of gravity are needed for establishing several physical standards: . . . The techniques currently in use for making these various measurements are described, including surface-ship airborne surveys. The sources of error in each type of measurement are discussed and the presently obtainable accuracies indicated.

GRAVITATIONAL RADIATION
F.A.E. Pirani, In: Gravitation: An Introduction to Current Research, New York, John Wiley and Sons, Inc., 1962, p. 199/226, 118 refs., A63-15542.

Review of the difficulties of understanding the structural features of the gravitational field, and the methods devised to overcome these difficulties. The special features of the gravitational field are considered. Attempts to resolve the problems involved by the use of coordinate conditions and by perturbation methods are described, including the expansion procedure, Synge's argument and Trautman's criticism, and the "new approximation method of Einstein, Infeld and Hoffman. Multipole approximation methods are summarized, and the Riemann-tensor analytic techniques are discussed, including the algebra and geometry of the tensor and the propagation of gravitational fields. Some exact vacuum solutions of the field equations interpreted as representing radiation are briefly investigated.

GRAVITATIONAL RADIATION
F.A.E. Pirani, King's Coll., U. of London (Gt. Brit.), Report on Gravitational and Electromagnetic Field Physics, May 1962, 33 p., AD 298 960.

ON GRAVITATIONAL WAVES AND NONLINEAR ELECTROMAGNETIC THEORY (Correspondence)
H. Unz, Proc. IRE, vol. 50, no. 7, July 1962, 1710.

ONDES MATERIELLES DE SPIN 0 ET DE SPIN 1 COUPLEES AU CHAMP GRAVITATIONNEL (Material Waves of 0 and 1 Spin Coupled with a Gravitational Field) (In French)
O. C. de Beauregard, Academie des Sciences Pairs, Comptes Rendus, vol. 256, no. 12, 18 March 1963, p. 2541/2543, A63-17085.

GRAVITATIONAL MACHINES
F.J. Dyson, In: Interstellar Communication, Edited by A.G.W. Cameron, New York and Amsterdam, W.A. Benjamin, Inc., 1963, p. 115/120, A64-10222.

Discussion of the problems of building machines to harness the energy of the gravitational field. It is stated that a pulse of gravitational radiation of magnitude $E = 3 \times 10^{52}$ ergs at a frequency around 200 cycles should be detectable with Weber's existing equipment, at a distance of the order of 100 Mparsecs. Thus the death cry of a binary neutron star could be heard on Earth, if it happened once in 10 million galaxies. It would seem worthwhile to maintain a watch for events of this kind, using Weber's equipment or some suitable modification of it.

THESES OF THE FIRST SOVIET GRAVITATION CONFERENCE HELD IN MOSCOW IN THE SUMMER OF 1961
M.A. Garbell, Garbell Research Foundation, San Francisco, Calif., 1963, 130 p., 138 refs., N63-22839.

. . . Abstracts are compiled . . . The subjects . . . were . . . The classical theory of gravitation dealing with the algebraic structure of the Einstein equations, equations of motions new solutions, and the Schwarzchild singularity; the classical theory of gravitation dealing with the energy impulse tensor, antigravitation and gravitational waves; non-Riemannian generalizations of geometry; the quantum theory of gravitation and nonlinear equations; and cosmology and gravimetry.

SOME FREQUENTLY USED FORMS OF THE EARTH'S GRAVITY POTENTIAL
P.T. Guttman, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR 269 4550, SSD TDR 63 337, AD 431 845.

The nomenclature and forms of the earth's gravity potential are summarized in order to clarify and standardize the information for those who desire to keep abreast of the developments in this area of study. . . .

IS A GRAVITY SCREEN POSSIBLE
O. Kostko, Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 25 April 1963, 5 p., AD 408 499.

GRAVITATIONAL FIELD ENERGY AND g_{∞}
C.W. Misner, Physical Review, 2nd Series, vol. 130, May 15, 1963, p. 1590/1594, 30 refs., A63-17590.

Demonstration that one of the family of "generalized energy density" definitions by Komar (one for which the generalized energy density is made positive definite by use of minimal surfaces) leads to a total "Generalized energy".

GRAVITATIONAL FIELDS OF EARTH MODELS AND THE STRUCTURE OF THE EARTH INTERIOR
D. O. Lehn, RAND Corp., Santa Monica, Calif., May 1963, 9 p., RM3642 PR, AD 408 509.

THE PRINCIPLE OF EQUIVALENCE
F. Rohrlich, Ann. Phys., vol. 22, May 1963, p. 169/191, 24 refs., A63-17451.

. . . refers, roughly speaking, to the equivalence of inertial mass with passive and active gravitational mass. A static homogenous gravitation field (SHGF) is defined, followed by the corresponding description of free fall and the associated local geodesic coordinate system to be related to free fall in a noninertial system.

A METHOD FOR CORRECTING THE EFFECT OF GRAVITY ANOMALIES ON PRECISION INERTIAL NAVIGATION MAPPING SYSTEMS
B.R. Rubenstein, et al., Photogrammetric Engineering, vol. 30, March 1964, p. 225/229, 5 refs., A64-17060.

Presentation of two methods for correcting errors of inertial system caused by uncorrected gravity anomalies. Equations describing these errors are derived. Two methods of correction are considered: programming the anomalies in the guidance computer, and gravimetrically sensing the anomalies during flight, with subsequent correction during data reduction. It is seen that the latter method, being self-contained and requiring no previous gravimetric survey, appears particularly promising.

DETECTION AND GENERATION OF GRAVITATIONAL WAVES
Aerospace Information Div., Washington, D.C., AID P63 77, Comprehensive rept., 24 May 1963, 38 p., AD 411 270.

Soviet open literature published between December 1959 and March 1963 is summarized. A series of critiques by Soviet physicists of research and experiments conducted in the field of gravitation is included.

RESEARCH INTO GRAVITY MEASURING TECHNIQUES
Barkley and Dexter Labs., Inc., Boston, Mass., Final rept., AFCRL Rept. no. 63 665, March 1963, 56 p., AD 412 923.

. . . two AFCRL relative gravity bi-pendulum apparatus are discussed. Operating instructions and details of data acquisition and reduction are also presented. . . .

Related Publications:

NEWTONIAN EQUATIONS OF MOTION AND HARMONIC CONDITIONS IN THE THEORY OF GRAVITATION
C. Jankiewicz, Foreign Tech. Div., Air Force Systems Command, Wright Patterson AFB, Ohio, 15 Aug. 1963, 15 p., AD 420 865.

The relation between Newtonian equations of motion and harmonic conditions in Einstein's theory of gravitation is examined . . .

EFFEKT MESSBAUERA I TEORIIA OTNOSITEL'NOSTI (The Mossbauer Effect and the Theory of Relativity) (In Russian)
Ia. A Smorodinskii, Uspekhi Fizicheskikh Nauk, vol. 79, April 1963, p. 589/594, 10 refs., A63-16887.

Detailed analysis of Pound's experiments in which the effects of the gravitational field upon photon frequency are demonstrated. . . .

A SOLUTION OF EINSTEIN'S FIELD EQUATIONS FOR A ROTATING, STATIONARY, AND DUST-FILLED UNIVERSE
J. P. Wright, Wisconsin U., Madison, Technical Summary Report, Dec. 1963, 12 p., refs., AD 433 478, N64-17635

Section 3B.57:

3B.570: Novel Propulsion Methods for Space Flight

Included: Effect of propulsion methods on communications systems; Electric thrust devices; Electric propulsion; Electron bombardment ion engines; RF noise generation from ion engines; Electric space cruiser; Plasma propulsion system; Ionic ramjet propulsion.

Not Included: Propulsion technology; Influence of exhaust fumes on communications.

Principal Publications:

AN EXPERIMENTAL PLASMA PROPULSION SYSTEM
M.J. Minneman, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 167/174.

A PRELIMINARY ANALYSIS OF AN IONIC THRUST DEVICE FOR SPACE FLIGHT APPLICATIONS
M.J. Raether, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 448/455.

IONIC RAM JET PROPULSION FOR MAINTAINING SATELLITES IN ORBIT AGAINST DRAG
J. Rothstein, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 175/178.

IONIC PROPULSION FOR SPACE VEHICLES
J.R. Anderson, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 213/219.

POTENTIALITIES OF ELECTRON BOMBARDMENT ION ENGINES FOR ELECTRIC PROPULSION
D.J. Kerrisk, IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 188/193.

ELECTRIC THRUST DEVICE REQUIREMENTS FOR INTERPLANETARY SPACECRAFT
J.H. Molitor, et al., IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 183/187.

Two missions, a Mars orbiter and a Jupiter capture, chosen as representative of the time periods following 1965 and 1970, respectively, are analyzed to determine the thrust and specific impulse requirements of an electric propulsion system. The state of the art of electric thrust devices is discussed, and it is concluded that, with expected advances, ion motors can meet all of the requirements of interplanetary missions, with magnetohydrodynamic motors a promising backup. . . .

THE ELECTRIC SPACE CRUISER FOR HIGH ENERGY MISSIONS
R.J. Beale, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 1963, 11 p., AD 406 667.

A basic spacecraft capable of significant, unmanned exploration of significant, unmanned exploration of the entire Solar System can be achieved by the use of a modest nuclear-electric propulsion system employing a Saturn-B booster chain . . . With an ultimate 2-year propulsion system lifetime goal the spacecraft would be able to orbit Jupiter and to probe the remainder of the Solar System . . .

THE GENERAL LIMITS OF SPACE TRAVEL
S. von Hoerner, In: Interstellar Communication, Edited by A.G.W. Cameron, New York and Amsterdam, W.A. Benjamin, Inc., 1963, p. 144/159, A64-10224.

Examination of the future possibility of interstellar space travel for terrestrians, and of the present possibility of travel from star to star for more advanced extra-terrestrial beings. The definitive answer is not that interstellar space travel is absolutely impossible. . . . The conclusion drawn is that space travel, even in the most distant future, will be confined completely to our own planetary system, and a similar conclusion will hold for any other civilization, no matter how advanced it may be. The only means of communication between different civilizations thus seems to be electro-magnetic signals.

INVESTIGATION OF RF NOISE GENERATION FROM SPACE VEHICLES
R.D. Wanselow, IEEE Trans. Commun. Syst., vol. CS-11, no. 3, Sept. 1963, p. 346/351.

Analytical and experimental studies have been made on RF noise generated by two types of ion propulsion engines, namely the cesium contact ion engine and the Penning discharge engine. . . . No noise was experimentally observed from the cesium contact engine over the frequency spectrum of 38 to 2200 Mc, but the Penning engine exhibited electron cyclotron radiation. Preliminary conclusions of this study are that reliable communications systems with a vehicle involving a Penning discharge propulsion engine should probably be operated above the cyclotron and plasma frequencies. . . .

Related Publications:

A SUMMARY OF THE TRAJECTORY ANALYSIS AND PROPULSION REQUIREMENTS FOR ADVANCED PROPULSION SPACECRAFT
C. Sauer, et al., JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 1/4.

. . . The development of optimum thrust programs for nuclear-electric propulsion systems has assumed considerable importance in assessing the payload capabilities of these advanced spacecraft. The thrust programs considered have had various kinds of propulsion-type constraints imposed on them. . . . possesses a separate power supply to generate the kinetic energy of the propellant. This power supply is necessarily limited in its power output and requires the allocation of a significant fraction of the vehicle weight. The first studies employed the so-called variable thrust program which had no constraints other than the power-limited constraint. For the Mercury and Mars missions, both circular and eccentric orbits were used, the remaining planets including the Earth employed circular orbits in all cases. . . .

Section 3B.58

3B.580: Other Related Techniques for Potential Space Communications Applications

Included: Communications via seismic waves (on celestial objects); Elastic waves; High altitude acoustic waves.

Not Included: Extra low frequency propagation on Earth (1).

Principal Publications:

EXPLOITING OTHER COMMUNICATIONS MEDIA
J.L. Ryerson, Electronics Industr., vol. 18, no. 3, March 1959, p. 79/83.

EXPLOITATION OF PHYSICAL PHENOMENA FOR COMMUNICATIONS
J.L. Ryerson, Rome Air Development Center, RADC TN 58-277, Oct. 1958, 14 p., AD 148 939.

Investigation of communications through natural ducts by the use of low frequency radio sound, light, heat, and gamma rays.

STUDY OF FIELD EMISSION FROM SEMICONDUCTORS: FIELD EMISSION APPLICATIONS: ELECTRON GUNS FOR FIELD EMISSION BEAMS
R.M. Charbonnier, et al., Linfield Research Inst., McMinnville, Oreg., Final technical rept., 1 May 1957-31 Dec. 1960, 31 Dec. 1960, 58 p., illus., 46 refs., AD 282 367.

. . . Fabrication of field emission tips, operation of tips in a field emission projection microscope, interpretation of field emission patterns, migration processes, doping of tip material, tip geometry, tip temperature, and operation in a boron-free environment. Field emission applications are reported. A study of the electrostatic focusing of high current density field emission beam is described.

FIELD EMISSION, A NEWLY PRACTICAL ELECTRON SOURCE
W. P. Dyke, IRE Trans. Mil. Electronics, vol. MIL-4, no. 1, Jan. 1960, p. 38/45.

DIAGNOSTIC INSTRUMENTATION FOR AN ELECTRIC PROPULSION PLASMA ENGINE
L. Aronowitz, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 151/156.

EXOTIC METHODS IN SPACE COMMUNICATIONS
L. R. Bittman, Conv. Rec. Nat. Symp. Global Commun., May 1961, p. 10/13.

IONIC AND PLASMA PROPULSION FOR SPACE VEHICLES
G. R. Brewer, et al., Proc. IRE, vol. 49, Dec. 1961, p. 1789.

A SURVEY OF THE ELEMENTS OF POWER TRANSMISSION BY MICROWAVE BEAM
W. C. Brown, IRE Internat. Conv. Rec., vol. 3, March 1961, p. 93/106.

EXTREMELY LOW FREQUENCY RECEPTION AT KINGSTON, R.I.
C. Polk, et al., Rhode Island U., Kingston, Scientific rept. no. 1, Rept. no. 7252/1, 15 Nov. 1961, 17 p., 19 refs., AD 270 856.

Magnetic fields of natural origin in the 5 to 20 c.p.s. frequency range were recorded in Kingston, R.I. Variations with time of the first resonant frequency of the earth-ionosphere cavity are indicated, and effects of solar activity are discussed. An analysis of the envelope of recorded wave trains shows only fair agreement with existing theory.

FLUID AMPLIFIERS FOR AEROSPACE SYSTEMS
W. G. Wadey, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 353/358.

A SOLID-STATE SELF-SCANNING DISPLAY DEVICE
M. S. Wasserman, General Telephone and Electronics Labs., Inc., Bayside, N.Y., Final Report, RADC-TDR-62-601, TR-62-204.18, Nov. 30, 1962, 47 p., N63-15829.

. . . the electric field for activation of the electroluminescent layer is provided by elastic waves. These waves are propagated through a piezoelectric ceramic plate which serves as the substrate for the display.

COMMUNICATION VIA SEISMIC WAVES
K. Ikrath, et al., Army Electronics Research and Development Agency, Ft. Monmouth, N.J., AELRDL TR2346, May 1963, 155 p., AD 429 786.

. . . design and performance of experimental seismic transducers are discussed. The significance of the results of experiments with these transducers for seismic communication . . . is emphasized.

DIVISION 3B.6
BIONICS

This division contains in a single subdivision a number of selected references from the expanding field of bionics. The great variety of the references may indicate the multitude of interactions between this new science and problem areas of space communications.

It is still too early to predict the precise impact which bionics will have on space electronics. The compilers of this bibliography, therefore, desisted from further subdividing this area.

Section 3B.60

3B.600

Included: Mechanism of perception; Muscle substitutes; Concept learning; Networks simulating the nervous system; CONFLEX I, electronic stimulators; Photic stimulator; Neuristor; Perceptron; Logisticon; Self-reproducing system; Genetic control systems; Bionic information storage systems; Glial control; Neuronal activity; Relational biology and bionics; Plastic neurons; Coding theories of the nervous system; Biax perception; Neurocybernetics; Neurotron networks.

Not Included: Simulation of mental processes (3A); Automation (3A); Theory of sequential circuits and machines (3A); Biological sensors (3A); Bio-telemetry systems (3A); Coding theories (2).

Principal Publications:

SYMBOLIC LOGIC AND INTELLIGENT MACHINES
E. C. Berkeley, New York, Reinhold Publishing Corp., 1959, 208 p.

DIGITAL SIMULATION IN PERCEPTUAL RESEARCH
E. E. David, Jr., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 322/328.

A SELF-ORGANIZING BINARY SYSTEM
R. L. Mattson, Proc. Eastern Joint Comp. Conf., Dec. 1959, p. 212/217.

. . . concerned with pattern-recognition processes in which the pattern classes are determined by the so-called "linearly separated" Boolean functions.

A REVIEW OF THE PERCEPTRON PROGRAM
A. E. Murray, Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 346/356.

"Perceptron" is the class name for a family of pattern recognition machines. They can learn to discriminate several categories. After exposure to a few samples in a category, such a machine tends to recognize spontaneously or classify correctly a new sample. . . .

PLASTIC NEURONS AS MEMORY ELEMENTS
D. G. Willis, IRE WESCON Conv. Rec., no. 4, 1959, p. 55/65.

Studies of the logical elements, neurons, of the human brain carried out in order to construct machines capable of "pattern recognition" or "learning" are discussed.

NEURON COMPONENT DEVELOPMENT
T. E. Bray, et al., General Electric Co., Syracuse, N. Y., Semi-annual rept., 15 Nov. 1959-31 Jan. 1960, 1 v., AD 432 795.

The neuron circuitry will be composed primarily of electroluminescent and photoconductive materials, while multihole magnetic devices are used for the stable memory elements. . . .

STUDY OF UNIQUE DETECTION TECHNIQUES
J. O. Burgess, et al., Antenna Lab., Ohio State U. Research Foundation, Columbus, Final engineering rept., vol. 1, 1 Dec. 1959-30 Nov. 1960, Rept. 1040-1, 1 Dec. 1960, 39 p., AD 257 085.

. . . for surveillance applications . . . special attention given to biologic detectors . . . Two experimental detectors are described and other detection schemes are suggested. Superregeneration is extended to the D. C. case where it is compared with the behavior of nerve membrane. It is concluded that detectors based on quantum mechanical principles offer the ultimate in sensitivity and frequency range while detectors based on neurophysiological schemes offer the ultimate in small size and high gain.

THE NEURISTOR (Correspondence)
H. D. Crane, IRE Trans. Electronic Comp., vol. EC-9, no. 3, Sept. 1960, p. 370/371.

A novel device and its properties have been hypothesized and possible digital systems employing it are briefly outlined in this note. The device, termed Neuristor, may be used to synthesize all digital logic functions, so that any digital logic system can be realized using arrays of neuristors only.

NATURE'S CONTRIBUTION TO CORRELATION PROCESSES
L. A. deRosa, et al., Bionics Symp., no. 60-600, Sept. 1960.

There is sufficient data available from physiological studies of the mammalian ear to permit engineers to construct an electrical analog of the cochlear system.

ELECTRONIC STIMULATORS
G. Edsall, Proc. Instn. Radio Engrs. Australia, vol. 21, no. 7, July 1960, p. 459/461.

The circuits and performance of electrical, photic and auditory stimulators are outlined. . . .

ACTIVITY IN NETWORKS OF NEURON-LIKE ELEMENTS
B. G. Farley, et al., Proc. Nat. Aeron. Electronics Conf., vol. 8, May 1960, p. 227/233.

INDUSTRIAL, BIOLOGICAL AND MEDICAL ASPECTS OF MICROWAVE RADIATION
A. F. Harvey, Proc. Instn. Elect. Engrs. Pt. B, vol 107, no. 36, Nov. 1960, p. 557/566.

The paper reviews the industrial, biological and medical aspects of microwave radiation. . . . concludes with a bibliography of 108 references. . . .

ELECTRONICS IN ELECTROPHYSIOLOGY
M. E. Holman, Proc. Instn. Radio Engrs. Australia, vol. 21, no. 7, July 1960, p. 457/459.

. . . a Symposium of five papers on medical electronics . . .

AN ANALOGUE COMPUTER FOR SEPARATING EVOKED PHYSIOLOGICAL POTENTIALS FROM BACKGROUND NOISE
W. J. Kropfl, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 57/60.

LOGISTICON
W. S. McCulloch, In: Aspects of the Theory of Artificial Intelligence, International Symposium on Biosimulation, 1st, Proceedings, Locarno, Switzerland, June 29-July 5, 1960, New York, Research supported by USAF, Army, Navy, National Institute of Health, and Teagle Foundation, Inc., A63-17875.

Extension of the theory of any logical function of arguments (which can be represented by a single Venn diagram each of whose spaces contain a 0 or 1 in Boolean fashion) to probabilistic logic. The extension is based on the introduction of p's in places normally restricted to 0 or 1 (where p is greater or equal to 0, and smaller or equal to 1), and it produces a way of evaluating all such functions on simple digital calculators. . . .

SYNTHESIS OF RELIABLE AUTOMATIC AND STABLE NEURAL NETS
K. K. Maitra, Bionics Symp., Sept. 1960, p. 353/394.

. . . considers the problem of the design of reliable circuits from unreliable modules. The basic module is the triplet network consisting of three functions of two variables.

THE LOGIC OF BIOSIMULATION. Appendix – THE DNA-PROTEIN CODE AND THE LINEAR REPRESENTABILITY OF n-DIMENSIONAL CONFIGURATIONS. A CONCEPT OF INTEGRATION CAPABLE OF INTEGRATING THE HEAVISIDE UNIT FUNCTION. PROOF OF THE AXIOM OF CHOICE.
C. A. Muses, In: Aspects of the Theory of Artificial Intelligence, International Symposium on Biosimulation, 1st, Proceedings, Locarno, Switzerland, June 29-July 5, 1960, New York, Plenum Press, Inc., 1962, p. 115/163, 249/271, 37 refs., A63-17876.

THE THEORETICAL CHANNEL CAPACITY OF A SINGLE NEURON AS DETERMINED BY VARIOUS CODING SYSTEMS
A. Rapoport, et al., Inform. Control, vol. 3, no. 4, Dec. 1960, p. 335/350.

AIR FORCE RESEARCH ON LIVING PROTOTYPES
H. E. Savely, Bionics Symp., no. 60-600, Dec, 1960, p. 41/47.

. . . Three aspects of animal systems are discussed in this connection: 1) sensory receptors, 2) the integrative action of nervous systems, and 3) the storage and retrieval of information.

COMPUTERS AND SENSORY NEUROPHYSIOLOGY
W. R. Uttal, Proc. Nat. Aeron. Electronics Conf., vol. 8, May 1960, p. 221/226.

AN ADAPTIVE "ADALINE" NEURON USING CHEMICAL "MEMISTORS"
B. Widrow, Stanford Electronics Labs., Stanford U., Calif., 17 Oct. 1960, AD 244 790.

A new circuit element called a "memistor" (a resistor with memory) has been devised that will have general use in adaptive circuits. With such an element it is possible to get an electronically variable gain control along with the memory required for storage of the system's experiences or training. Experiences are stored in their most compact form, and in a form that is directly usable from the standpoint of system functioning . . . The memistor promises to be a cheap reliable, mass-producible, adaptive-system element.

TOWARD INTELLIGENT MACHINES
J. D. Williams, RAND Corp., Santa Monica, Calif., Rept. no. P2170, 29 Dec. 1960, 13 p., AD 432 330.

Descriptors: Artificial intelligence . . . Nerve cells, Simulation . . .

SELF-ORGANIZING SYSTEMS: PROCEEDINGS OF AN INTERDISCIPLINARY CONFERENCE
M. C. Yovits and S. Cameron (editors), New York, Pergamon Press, N. Y., N. Y., 1960, 331 p.

This paperback book represents the official proceedings of an interdisciplinary conference on the subject of cognitional systems that was held in Chicago on May 5-6, 1959. The main body of this well-edited and well-reproduced work consists of 13 technical papers (averaging better than 20 pages apiece) contributed by 15 eminent researchers whose background includes the fields of philosophy, electrical engineering, physiology, and psychology.

SHORT-TERM MEMORY IN VISION
E. Averbach, et al., Bell Syst. Tech. J., vol. 40, no. 1, Jan. 1961, p. 309/328.

Experiments are performed that demonstrate some of the functional properties of short-term storage in the visual system, its decay, readout and erasure. Results indicate that the visual process involves a buffer storage which includes an erasure mechanism that is local in character and tends to erase stored information when new information is put in. . . . eye movements play an important role in the perception of form, and that perceptions of complicated visual fields are built up from information gathered during many fixations of the eyes.

AN OPTOELECTRONIC-MAGNETIC NEURON COMPONENT
T. E. Bray, Proc. Nat. Electronics, Conf., vol. 17, Oct. 1961, p. 322.

NEURON COMPONENT DEVELOPMENT
T. E. Bray, et al., General Electric Co., Syracuse, N. Y., Final rept., 15 Nov. 1959-15 Jan. 1961, 15 Jan. 1961, 138 p., AD 432 861.

. . . The problems and approaches to construction of a neuron circuit which is very compact and consumes little power are discussed. . . . A 20 input g-set, consisting of more than forty analog multipliers and twenty analog memory elements, and occupying approximately 2.5 cubic in. while consuming about 0.5 watts was assembled. . . .

THE VISILOG: A BIONIC APPROACH TO VISUAL SPACE PERCEPTION AND ORIENTATION
W. Carel, et al., Proc. Nat. Aerospace, Electronics Conf., vol. 9, May 1961, p. 295/300.

SOVIET CYBERNETICS AND COMPUTER SCIENCES--1960
E. A. Feigenbaum, IRE Trans. Electronic Comp., vol. EC-10, vol. 4, Dec. 1961, p. 759/776.

. . . The author's report of his visit to the Soviet Union in June and July, 1960. . . .

THE ADAPTIVE FILTER: A BIONIC APPROACH TO RECOGNITION
F. L. Hiltz, Proc. Nat. Aerospace Electronics Conf., vol. 9, May 1961, p. 132/133.

IMPROVED TRANSISTOR NEURON MODELS
E. P. McGrogan, Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 302.

COMPUTER SIMULATION OF HUMAN THINKING
A. Newell, RAND Corp., Santa Monica, Calif., Rept. no. P2276, 20 April 1961, 23 p., AD 432 469.

. . . a computer program the General Problem Solver, instructed to solve the same problem as the human subject. This use of computers for nonnumerical simulation of symbol-manipulating processes offers a solution to the dilemma that psychology has faced--that the problems of fundamental importance to the field have not always been those that existing research techniques were equipped to handle. Computer simulation promises to provide a powerful tool for constructing and testing theories of complex cognitive behavior.

A CLASSIFICATION SCHEME FOR BIONICS
R. K. Overton, Proc. Nat. Aerospace Electronics Conf., vol. 9, May 1961, p. 284/286.

ANALYTIC PROOF OF OPERABILITY OF A SECOND-ORDER NEURISTOR LINE
M. C. Pease, Stanford Research Inst., Menlo Park, Calif., Rept. for 23 June 1960-30 June 1961 on Molecular Electronics, ASD TN 61-40, June 1961, 45 p., AD 263 631.

The equations for a particular type of Neuristor are studied and sufficient conditions developed for the existence of the type of solutions required . . . The term "Neuristor" . . . describes a very general class of nonlinear devices that exhibit some of the propagation properties of the nerve axon.

SPEECH RECOGNITION BY NEURAL NETWORKS
F. L. Putzrath, et al., Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 311.

SENSORY COMMUNICATION: CONTRIBUTIONS TO THE SYMPOSIUM ON PRINCIPLES OF SENSORY COMMUNICATION
W. A. Rosenblith (Editor), Cambridge, Mass., Technology Press of Mass. Inst. of Tech, New York, John Wiley & Sons, Inc., 1961, 842 p.

. . . Symposium held at M.I.T. in 1959 . . .

BIONICS FOR AEROSPACE SUPREMACY
J. K. Schloss, Proc. Nat. Aerospace Electronics Conf., vol. 9, May 1961, p. 287/293.

THE SIMULATION OF COGNITIVE PROCESSES: AN ANNOTATED BIBLIOGRAPHY
P. L. Simmons, et al., IRE Trans. Electronic Comp., vol. EC-10, no. 3, Sept. 1961, p. 462/483, 498 refs.

Mathematical models, automata and probabilistics. Formal nerve nets. Simulated neurons and organisms. Patern recognition. Learning systems. Language processing.

AUTOMAT UND MENSCH. UBER MENSCHLICHE UND MASCHINELLE INTELLIGENZ (Automatic Machines And Man; On Human And Artificial Intelligence) (In German)
K. Steinbuch, Berlin, Springer-Verlag, 1961, 253 p.

CYBERNETICS, OR CONTROL AND COMMUNICATION IN THE ANIMAL AND THE MACHINE (Second Edition)
N. Wiener, New York, John Wiley & Sons, Inc., Cambridge, Mass., MIT Press, 1961, 212 p.

More than thirteen years have passed since the first edition of "Cybernetics" was published. In this new edition Prof. Wiener has added a special preface, a chapter on Learning and Self-Reproducing Machines, one on Brain Waves and Self-Organizing Systems (together 34 pages) and a 9 page index. . . .

LERNENDE AUTOMATEN. BERICHT UBER DIE FACHTAGUNG DER NTG IN KARLSRUHE AM 13. UND 14. APRIL 1961 (Learning Automatons; Report on a Symposium in Karlsruhe, 1961) (In German)
Munchen, R. Oldenbourg Verlag, 1961, 240 p.

THE SELF-REPRODUCING SYSTEM
W. R. Ashby, In: Aspects of the Theory of Artificial Intelligence, International Symposium on Biosimulation, 1st, Proceedings, Locarno, Switzerland, June 29-July 5, 1960, New York, Plenum Press, Inc., 1962, p. 9/18, A63-17871.

. . . a system so constructed that if there occurs within it a certain form (or property, or pattern, or recognizable quality generally), then a dynamic process occurs, involving the whole system. The dynamic process is of such a nature that eventually we can recognize, in the system, further forms closely similar to the original. . . .

SEQUENTIAL PHENOMENA IN PSYCHOPHYSICAL JUDGMENTS: A THEORETICAL ANALYSIS
R. C. Atkinson, et al., IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. 155/162.

. . . analysis of psychophysical detection experiments designed to assess the limit of a human observer's level of sensitivity. A mathematical theory of the detection process is introduced that, in contrast to previous theories, provides an analysis of the sequential effects observed in psychophysical data. Two variations of the detection task are considered: information feedback situation the subject is given information concerning the correctness of his responses, whereas in the no-feedback situation he is not. . . .

TOLERABLE ERRORS OF NEURONS FOR INFALLIBLE NETS
M. Blum, et al., IN: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 66/69.

SELF-ORGANIZING MODELS - THEORY AND TECHNIQUES
E. B. Carne, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 499/508.

THE CONDITIONS OF COMMUNICATION
J. D. Chapline, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 685/689.

The human individual is a psycho-dynamic organism in continuing relationship with environment. This relationship includes all the remembered past experiences, new data coming in from current new experiences, and the continual marshalling of energy in reaction to the new data. . . . These observations are pertinent to the communication problem because, whether by word, gesture, music, or any other form of human communication, every new experience, representing a reaction between an individual and the external world, must be registered along communication channels.

NEURISTOR – A NOVEL DEVICE AND SYSTEM CONCEPT
H. D. Crane, Proc. IRE, vol. 50, no. 10, Oct. 1962, p. 2048/2060.

. . . hypothesized. . . . The device is not discrete; it is rather a distributed "line" with active and passive processes so distributed that a signal propagates along the line without attenuation, much as a burning zone moves along a fuse or an ionic discharge along a nerve axon. It is shown that lines of this type can be interconnected in certain direct ways so that complete logic capability can be achieved with networks of such lines alone. . . .

SIMULATION OF A BIOLOGICAL SYSTEM ON AN ANALOG COMPUTER
E. C. DeLand, IRE Trans. Electronic Comp., vol. EC-11, no. 1, Feb. 1962, p. 17/25.

. . . construction of a mathematical model of a large biological system. This method, based on Gibbs' free energy hypothesis, uses the format of mathematical programming, while the actual computation is accomplished by the method of steepest descent. The biological system chosen to exemplify the mathematical method was the respiratory function of the blood in the human lung.

COMMUNICATION BY ELECTRICAL STIMULATION OF THE SKIN
E. Foulke, Louisville U., Ky., Annual progress rept., 1 Nov. 1961-1 Nov. 1962, 1 Dec. 1962, 17 p., incl. illus., AD 294 648.

. . . With this equipment it is possible to present stimuli that are controlled with respect to frequency, intensity, duration and locus. Stimuli may be presented manually, by means of a keyboard, or automatically, at predetermined sequences and rates, by means of punched tape . . . code contains thirty-nine different stimuli. . . . taken directly from the Braille code. . . .

MATHEMATICAL MODELS FOR THE ALL-OR-NONE ACTIVITY OF SOME NEURONS
G. L. Gerstein, IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. S137/143.

. . . Measurements of the statistical properties of spike trains from single neurons are used to suggest a mathematical model based on a random walk toward an abosrbing barrier. . . .

THE RESISTANCE OF BATS TO JAMMING
D. R. Griffin, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 285, 23 Oct. 1962, 26 p., incl. illus., tables, 18 refs., AD 296 493.

ANALOG MODELS OF NEURAL MECHANISM
L. D. Harmon, et al., IRE Trans. Inform. Th., vol. IT-8, no. 2, Feb. 1962, p. 107/112.

ITERATIVE SWITCHING NETWORKS COMPOSED OF COMBINATIONAL CELLS
W. Kilmer, IRE Trans. Electronic Comp., vol. EC-11, no. 2, April 1962, p. 123/131.

MEETING CONCERNING THE BIOLOGICAL ASPECTS OF CYBERNETICS
V. G. Korcherezhkin, Joint Publications Research Service, San Francisco, Calif., JPRS: 16631, 11 Dec. 1962, 9 p. AD 299 370.

ARTIFICIAL INTELLIGENCE: A SUMMARY OF CURRENT RESEARCH AND DEVELOPMENT
P. A. Lachenbruch, et al., American Inst. for Research, Los Angeles, Calif., AIR-C63-2/62-TR, Feb. 1962, 178 p., refs., N64-19616.

. . . examining existing physical, mathematical, and logical models of brain functions . . . Relevant literature . . . was reviewed to update the literature searches previously performed . . . general headings of neurological considerations, special purpose computer models, and general computer program models. A bibliography of 1,129 supplementary specific references and 67 general sources (proceedings of symposia and conferences, anthologies and relevant bibliographies) is presented . . .

THEORY OF PROBABILITY STATE VARIABLE SYSTEMS, VOLUME VI: PERCEPTION, DECISION-MAKING, AND ACTION
R. J. Lee, Adaptronics, Inc., Alexandria, Va., Final rept., 15 Oct. 1961-14 Oct. 1962, ASD TDR63 664, vol. 6, AD 427 771.

. . . discusses approaches whereby Neurotron Networks can be used to provide pattern recognition, autonomous decision-making, and action . . . an artificial fovea with jitter analogous to the human eye is described, and how this, together with a Neurotron network, can learn to assign meaning to symbols, including the ability to learn to recognize hand-printed letters . . . it is shown how a Neurotron network can develop its own strategy for playing chess. . . .

COMMUNICATION DEVELOPMENTS IN LIFE SCIENCES
L. B. Lusted, IRE Internat. Conv. Rec., Pt. 8, vol. 10, March 1962, p. 40/41.

. . . some communication projects for the biomedical sciences . . . development of a family of computers for use in the biomedical sciences. . . .

THE UTILITY OF ANASTOMOTIC NETS – INTRODUCTION
W. S. McCulloch, In: Redundancy Techniques for Computing Systems, R. H. Wilcox and W. C. Mann, editors, Washington, D. C., Spartan Books, 1962, p. 62/65.

NEW METHODS OF ANALYSIS OF ELECTROPHYSIOLOGICAL RESPONSES
D. M. MacKay, et al., Keele U., Gt. Brit., Final technical rept., 21 June 1962, 24 p., illus., 3 refs., AD 278 590.

. . . development of a simple system for the averaging and analysis of repeated electrical signals . . . Samples are accumulated on a closed loop of magnetic tape, using a special form of pulse-interval modulation, designed also to enable simple circuitry to compute correlations. A low-speed and a high-speed multi-channel model have been developed, with capacities of up to 900 samples per channel. First results with the E. E. G. of human subjects exposed to patterned visual stimuli are described.

DESIGN PRINCIPLES FOR AN INTELLIGENT MACHINE
M. E. Maron, IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. 179/185.

. . . discusses the role of prediction as the key process underlying the function of an intelligent machine. A model of a "neuron" is presented which exhibits properties of memory and learning. . . .

ON A UNIQUENESS THEOREM AND ITS APPLICATION TO A NEUROPHYSIOLOGICAL CONTROL MECHANISM
Z. A. Melzak, Inform. Control, vol. 5, no. 2, June 1962, p. 163/172.

AN ACTIVE PULSE TRANSMISSION LINE SIMULATING NERVE AXON
J. Nagumo, et al., Proc. IRE, vol. 50, no. 10, Oct. 1962, p. 2061/2070.

To electronically simulate an animal nerve axon, the authors made an active pulse transmission line using tunnel diodes. The equation of propagation for this line is the same as that for a simplified model of nerve membrane treated elsewhere. . . . this line has a certain threshold value in respect to the signal height, and signals smaller than the threshold or noise are eliminated in the course of transmission. . . .

THE SIMULATION OF LEARNING AND DECISION-MAKING BEHAVIOR. Addendum - COMMENTS ON EVOLUTIONARY AND SELF-ORGANIZING SYSTEMS
G. Pask, In: Aspects of the Theory of Artificial Intelligence, International Symposium on Biosimulation, 1st, Proceedings, Locarno, Switzerland, June 29-July 5, 1960, New York, Plenum Press, Inc., 1962, p. 165/210, 273/283, 46 refs., A63-17877.

AN ABSTRACT MACHINE BASED ON CLASSICAL ASSOCIATION PSYCHOLOGY
R. F. Reiss, Proc. AFIPS Spring Joint Computer, May 1962, p. 53/70.

. . . First, a "four-postulate machine" is discussed. . . . The machine is then extended by the addition of two further postulates which allow for learning to take place, according to the principle that the coupling between two memory tokens increases whenever they occur in the attention register simultaneously. Finally, an extension to a nine-postulate machine is discussed, in which sensory tokens flow through a sensory register and, thence, enter the attention register under specified conditions.

AN ELECTRONIC CONVERSATIONALIST (AND THE MACHINE REPLIED. . .)
E. Saprina, Joint Publications Research Service, San Francisco, Calif., JPRS: 16716, 17 Dec. 1962, 17 p., AD 400 016.

A discussion of electronic devices that speak and their relationship to the neurophysiology of human symbolic communication.

THE CODING OF VISUAL SIGNALS TO REDUCE CHANNEL-CAPACITY REQUIREMENTS
A. J. Seyler, Proc. Instn. Elect., Engrs, Pt. C, vol. 109, no. 16, Sept. 1962, p. 676/684, 35 refs.

Present-day communication-channel requirements for the transmission of visual information are based on fixed and independent threshold criteria for spatial, motion and contrast resolution. If, in accordance with the dynamic characteristics of the human sense of vision, time-variant and interdependent thresholds are introduced for these parameters, the required channel capacity may be reduced . . . This concept is developed into an integrated coding system for visual signals, making use also of intraframe and interframe correlations existing in television signals. Although it was possible to establish a formal system design, certain psycho-physical data as well as signal statistics have still to be measured to enable a reliable numerical evaluation of the attainable reduction in channel-capacity requirements. . . .

THE SIMULATION OF COGNITIVE PROCESSES, II: AN ANNOTATED BIBLIOGRAPHY
P. L. Simmon, et al., IRE Trans. Electronic Comp., vol EC-11, no. 4, Aug. 1962, p. 535/552.

. . . a supplement to the annotated bibliography that appeared in these Transactions last year. . . . to add 460 references that were not then included. These additional references bring forward the cutoff date for the cited publications to June, 1961, and expand the original bibliography by more than two hundred citations which were not available at the time the first installment was compiled.

A THEORY OF CORTICAL ORGANIZATION AND LEARNING
W. K. Taylor, IRE Trans. Inform. Th., vol. IT-8, no. 5, Sept. 1962, p. 144/149.

A theory of learning in the brain is described in terms of neuron types and their organization in cortical association areas. It is shown mathematically and by computer simulation that learning behavior can be produced by minute changes in synoptic transmission strength or weighting. Many feedback paths are involved and there is overall negative feedback through the thalamic reticular system. . . .

CONFLEX I -- A CONDITIONED REFLEX SYSTEM
M. R. Uffelman, IRE Internat. Conv. Rec., Pt. 4, vol. 10, March 1962, p. 132/142.

. . . The functional organization of a conditioned-reflex system (CR system) is presented . . . for the classification of minimally constrained stimuli. Given a system with an input retina containing N_s binary input cells, it is possible to describe 2^{N_s} black-white patterns. . . .

PRINCIPLES OF SELF-ORGANIZATION, VOL. 9
H. Von Foerster and G. W. Zopf, Jr. (editors), New York, Pergamon Press, Inc., 1962, 560 p.

. . . volume 9 of this series International Tracts in Computer Science and Technology and their applications.
Its contents are the transactions of the University of Illinois Symposium on self-organization held on June 8 and 9, 1961, under the sponsorship of Information Systems Branch, U. S. Office of Naval Research.
. . . 23 papers . . . artificial intelligence, mechanization of thought, automation of perception . . .

RELIABLE TRAINABLE NETWORKS FOR COMPUTING AND CONTROL
B. Widrow, et al., Stanford Electronics Labs., Stanford U., Calif., Nov. 1962, 10 p., AD 405 015.

. . . can perform their intended functions despite defective components, subassemblies, or interconnections . . . networks of adaptive or "trainable" linear elements called Adalines.

THRESHOLD LOGIC IN ARTIFICIAL INTELLIGENCE
R. O. Winder, David Sarnoff Research Center, Princeton, N. J., Scientific rept. no. 6, AFCRL-63-6, 15 Nov. 1962, 28 p., AD 298 784.

NEUROCYBERNETICS
Joint Publications Research Service, Washington, D. C., JPRS: 16638, 11 Dec. 1962, 172 p., 140 refs., AD 400 593.

Contents:
. . . Elements of the theory of networks
Systems capable of independently developing new programs for their operation
Forming new programs of operation by processing accumulated information
Problems of classifying shapes and concept formation by automata . . .

COMMUNICATION AND INFORMATION THEORY ASPECTS OF THE NERVOUS SYSTEM
E. Agilides, General Dynamics/Electronics, Rochester, N. Y., Annual summary rept., 1 Oct. 1962-30 Sept. 1963, 30 Sept. 1963, 57 p., AD 437 348.

. . . Multicoding-Unichannel and Multicoding-Multichannel Coding Theories of the Nervous System; Piezo-electric Mechanical Transducer System and Terminology Used in Shannon's Theorem.

A NET TO SIMULATE MORSE-CODE LEARNING
I. Barr, RAND Corp., Santa Monica, Calif., Jan. 1964, 33 p., AD 429 107.

. . . design of a neural net which can learn and recall six letters of Morse Code . . . The net, called MCN, can learn these coded equivalents in any order. By cascading the MCN with a sequence-recall net, a new net is created, called I, which is able to encode words after being taught the individual letter codes. . . .

SPECTRAL SCANNING AS A MECHANISM OF COLOR VISION
G. Biernson, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 103/108.

In perceiving color the eye performs a wavelength discrimination process which is analogous to the angular discrimination performed in a tracking radar. . . . This paper postulates that the eye employs the scanning discrimination principles to perceive color. A wavelength-dependent effect within the cone causes light of different wavelengths to produce different spatial distributions of energy in the photodetector region. An electrical process scans across this photodetector region producing a modulated waveform which defines the color information.
. . .

DETERMINATION AND DETECTION OF FEATURES IN PATTERNS
H. D. Block, et al., Cornell U., Ithaca, N. Y., RADC TDR63-497, Dec. 1963, 52 p., AD 427 840.

Feature determination as a method of training the first layer of weights in a two layer learning machine (Perceptron) is investigated. . . .

MUSCLE SUBSTITUTES AND MYO-ELECTRIC CONTROL
A. Bottomley, et al., J. Brit. Instn. Radio Engrs., vol. 26, no. 6, Dec. 1963, p. 439/448, 24 refs.

Muscle substitutes are defined and a description is given of some of those in use and under development. The possibility is suggested of controlling these devices by using the electrical potentials picked up over contracting muscles. . . .

LIMITS OF GENETIC CONTROL
H. J. Bremermann, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 200/205.

. . . The amount of information in the genes of humans and related species is estimated. . . . By comparing the information available in the genes with the information required by certain structures and behavior patterns it can be decided what the genes can control and what not. . . .

EXPERIMENTS IN ADAPTIVE PATTERN RECOGNITION
J. S. Bryant, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 174/179.

. . . experiments . . . to supply data concerning the power of some Perceptron-like adaptive pattern recognition systems using linear discriminate functions. . . .

FOREWORD (to the Special Issue on Bionics)
L. M. Butsch, et al. (Guest editors), IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 86/87.

. . . contains, for the most part, selected papers from the Bionics Symposium, 1963, which was held in Dayton, Ohio, March 19-21, 1963, under the sponsorship of the Aeronautical Systems Division and the Aerospace Medical Division of the Air Force Systems Command. . . .

BIONICS–STATUS AND PLANS
L. M. Butsch, Jr., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 261/266.

. . . past and present progress in bionics . . . Directions for future research . . .

RECOGNITION OF SOUNDS BY COCHLEAR PATTERNS
W. F. Caldwell, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 179/185.

An electrical analog of the human ear has been developed to provide real-time cochlear patterns of subjective loudness along the basilar membrane. Resulting spatial patterns may be analogous to those found in the auditory centers of the central nervous system. . . .

TOWARDS THE MECHANIZATION OF MENTAL ACTIVITIES
S. Ceccato, et al., Milan U., Italy, RADC TDR63 528, 20 July 1963, 64 p., AD 427 084.

. . . construction of a machine that observes and describes the events of its surroundings and its internal events ("Talking Automation") . . . conceptual difficulties which a program of this type gives rise to . . . block diagram of the machine and the scheme of the optical explorer with which the machine is equipped.

A NEW CONCEPT IN ARTIFICIAL INTELLIGENCE
J. P. Choisser, et al., Rome Air Development Center, Griffiss Air Force Base, N. Y., RADC TDR63 228, May 1963, 6 p., AD 409 111.

. . . CHILD (Cognitive Hybrid Intelligent Learning Device). CHILD is a self-adaptive learning machine which was conceived, designed, and constructed at the Information Processing Lab., Rome Air Development Center. . . . adaptive learning devices viewed as networks of redundant adaptive elements which are capable of being organized by some learning logic. . . . basically . . . a remapping of the sensory space in some manner which will enable decision elements to divide the remapped sensory inputs into various classes.

DYNAMIC INFORMATION HANDLING IN NEURISTOR SYSTEMS
H. D. Crane, et al., Computer Techniques Lab., Stanford Research Inst., Menlo Park, Calif., 1963, 43 p., AD 415 223.

Neuristor is the name given to any of a class of devices that exhibit attenuationless propagation with refractoriness, and includes the familiar nerve axon as a special case. . . .

A COMPARISON OF THE BAT'S SONAR EQUIPMENT WITH THAT BUILT BY HUMAN ENGINEERS
L. J. Cutrona, IEEE Internat. Conv. Rec., vol. 11, no. 3, March 1963, p. 167/171.

A FLEXIBLE NEURAL LOGIC NETWORK
G. J. Dusheck, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 208/213.

The process of learning is manifested by the modification of an organism's response to a given set of input stimuli. This altered response is brought about by a gradual change in the neural logic of the animal's nervous system. The authors show that gradual changes in logic can be achieved by the use of digital and analog properties of the natural prototype. . . .

HUMAN INFORMATION PROCESSING
M. Eden, IEEE Trans. Inform. Th., vol. IT-9, no. 4, Oct. 1963, p. 253/256, 60 refs.

THE PERCEPTRON CORRECTION PROCEDURE IN NON-SEPARABLE SITUATIONS
B. Efron, Stanford Research Inst., Menlo Park, Calif., RADC TDR 63 533, Feb. 1964, 19 p., AD 433 144, N64-18030.

The behavior of the standard Perceptron correction procedure when the underlying patterns are non-separable is discussed. . . . A converse to the usual Perceptron convergence theorem is presented.

SOME CONSIDERATIONS OF POLYSTABLE SYSTEMS
H. S. Fitzhugh, II, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 213/220.

. . . simulation on a large-scale computer. . . . to investigate the behavior of such systems as a function of the characteristics of the individual parts making up the system and the way in which the parts are joined together. A variety of behaviors has been observed by varying these two parameters for various input conditions. . . .

THE PORTRAYAL OF BODY SHAPE BY A SONAR OR RADAR SYSTEM
A. Freedman, J. Brit. Instn. Radio Engrs., vol. 25, no. 1, Jan. 1963, p. 51/64.

. . . This paper endeavors to clarify the mechanism whereby the eye perceives shape and to see how this is applicable to methods of display in sonar and radar equipment. . . .

CONSTRAINT ALGEBRA—A SUPERVISORY PROGRAMMING TECHNIQUE AND A COGNITIVE PROCESS
G. J. Friedman, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 163/167.

AN ELECTRONIC ANALOG OF THE EAR
E. Glaesser, et al., Santa Rita Technology, Inc., Menlo Park, Calif., AMRL TDR 63 60, June 1963, 66 p., AD 411 320.

REALIZABILITY OF INDUCTIVE LOGIC
M. C. Goodall, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 168/173.

CHILD AND SPOCK
P. H. Greene, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 156/159.

In order to study the structure and acquisition of perception and motor skills, we are simulating on a digital computer some features of a baby's sensorimotor development. . . .

A MODEL OF THE PLASTIC NEURON
V. V. Griffith, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 243/253.

Substantial physiological evidence indicates that neuron thresholds and synaptic weights in living creatures are adjusted by mechanisms quite different from those that have ordinarily been proposed in neural net investigations. This paper presents a theoretical model of the plastic neuron in which threshold and synaptic weights are adjusted solely on the basis of the time history of afferent and efferent activity of the neuron. Physiological, psychological and mathematical evidence is presented which supports the postulate that each neuron in living creatures is an autonomous, dynamically self-adjusting unit which is advised (not directed) by higher centers during the adjustment process. . . .

LARGE ARTIFICIAL NERVE NET (LANNET)
D. F. Guinn, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 234/243.

. . . implementation of a high speed self-organizing system based on the reinforcement principle. The self-organizing binary logical network is used as the primary component in the system. The learning system is a 1024 decision element network with a general purpose program to enable the operator to stimulate a large number of problems to study machine learning. . . .

AN INVESTIGATION INTO PATTERN INVARIANCE RECOGNITION CAPABILITIES OF THE HUMAN VISUAL SYSTEM
W. L. Harrison, Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, Aug. 1963, 111 p., AD 419 198.

. . . to find out how the human visual system performs pattern invariance recognition. A detailed study of the human visual system is made, a model of a portion of this system is derived, the model is simulated on a digital computer and tested to determine its pattern invariance recognition capabilities. . . .

RESEARCH ON BIAX TYPE ELEMENTS AND ASSOCIATED CIRCUITS (BIAX PERCEPTION)

J. K. Hawkins, et al., Aeronutronic, Newport Beach, Calif., Annual summary rept., 1 Feb. 1962-31 Jan. 1963, 31 Jan. 1963, 123 p., AD 404 048.

. . . three principles . . . have been formulated: (1) excess network capacity, (2) least-effortadaptation, and (3) network self-evaluation. A parallel logic technique has been developed which makes possible the economic mechanization of large learning networks.

FUNCTIONAL ELECTRONIC MODEL OF THE FROG RETINA

M. B. Herscher, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/-July 1963, p. 98/103.

. . . This system duplicates functionally the four image-feature-abstraction process found by Lettvin and co-workers . . .

SIMULATION OF HUMAN PROBLEM-SOLVING METHODS

A. D. Holden, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 489/496.

. . . This paper deals with the problem of finding sequences of transformations which constitute proofs of trigonometric identities. The method described need not be confined to this particular problem but could easily be used in other fields if the allowable transformations are known . . .

THEORY OF ADAPTIVE MECHANISMS

M. K. Hu, et al., Syracuse U., Research Inst., N. Y., Rept. no. EE894 6307F, RADC TDR 63 334, Dec. 1963, 110 p., AD 429 935.

. . . four different but related tasks. . . . (1) Information Contents of Time Continuous Processes. (2) Visual Pattern Recognition by Moment Invariants. (3) Control and Communication Systems in the Blood. (4) Experiments on the Use of Threshold Logic for Learning Machines. . . .

MOVING SOURCE MODEL OF NEURISTOR TRIGGERING

T. Janus, Proc.IEEE, vol. 51, no. 7, July 1963, p. 1049/1050.

Operation of a neuristor line is critically dependent upon the nearest neighbor interactions that induce lateral spread of the "discharge" along the trigger channel. This note describes a simple one-dimensional model of neuristor triggering when a concentration gradient is the principal driving force. . . .

TUNING BETWEEN CENTRAL AUDITORY PATHWAYS AND THE EAR

W. D. Keidel, IEEE Trans.Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 131/143, 62 refs.

DETECTION OF HUMANS IN CONCEALED PREPARED POSITIONS

A. T. Kornfield, Biosearch Co., Boston, Mass., Final rept., July 1963, 246 p., AD 427 150.

. . . attributes of man yielding signals, the signal modifications in environment and various sensing concepts in examining the capabilities of biosensing techniques . . . assembly of a catalog of chemical substances excreted through all body protals; for comparitive analysis, other human physical attributes and signals were set down (emission reflection, proximity properties), resulting in an inventory of most of the major signals produced by man . . .

TACTILE PRESENTATION OF VISUAL INFORMATION

K. Kotovsky, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 108/113.

Psychophysical experiments on tactile sensations were performed to determine parameters needed in the design of a tactile display containing about one hundred stimulators. This tactile display is being used to present spatial and temporal patterns to the skin to investigate the pattern recognition capabilities of the tactile sense. . . .

FUNCTIONAL CAPABILITY OF NEUROMINE NETWORKS FOR USE IN ATTITUDE STABILIZATION SYSTEMS

R. J. Lee, et al., Adaptronics, Inc., Alexandria, Va. Final rept., 15 March 1962-15 March 1963, ASD TDR63 549, Sept. 1963, 235 p., AD 429 116.

An adaptive network illustrating the use of Neurotrons (neuromines with the ability to learn both analog and logical functions) . . . data being provided by computer simulation. The use of this system for satellite attitude stabilization is described. Computer flow diagrams and programming data for simulating a Neurotron, Neurotron networks, and goal systems on a digital computer are described. . . .

THEORY OF PROBABILITY STATE VARIABLE SYSTEMS. VOLUME II: HISTORICAL DISCUSSION OF PSV DEVICES WITH EMPHASIS ON THE NEUROTRON

R. J. Lee, Adaptronics, Inc., Alexandria, Va., Final rept., 15 Oct. 1961-14 Oct. 1962, ASD TDR 63 664, vol. 2, Dec. 1963, 187 p., AD 428 099.

. . . traces the history and general background of Probability State Variable Devices, and defines their distinguishing features. The Reron, Artron, and Neurotron, each discussed in a separate section in this volume represent a major portion of the field of Probability State Variable (PSV) devices. Mention is given to another device, Halpern's Self-Organizing Binary Logical Network . . . and early related devices by Pierce, Kirsch, and Farley and Clark are noted. Most of these devices are able to learn logic functions, but the Neurotron combines logic with analog (gain-phase) functions, so that in the Neurotron, Logic, gain, and time-constants are all subject to learning.

MODELING OF NATURAL SELECTION IN A COMPUTER
A. A. Letichevskiy, et al., Joint Publications Research Service, Washington, D. C., In its Principles of the Design of Self-Learning Systems, 21 Oct. 1963, p. 57/65, N64-11033.

. . . This model consists of an environmental "medium" and "Inhabitants" capable of reacting to a change in outside conditions and of performing many types of functions. The environmental medium consists of a finite number of points situated along a circumference . . .

A NETWORK SIMULATING THE NERVOUS SYSTEM (In French)
J. C. Levy, Onde Electr., vol. 43, no. 433, April 1963, p. 435/451.

There already exist many models simulating the nervous system. These models designed abroad, mainly in the U. S. A., are specialized devices which can be built easily. Certain parts of the model proposed by the author may also be built practically, but its main object is the synthesis of most aspects of the actual nervous system of man and of the higher animals.

GLIAL CONTROL OF NEURONAL ACTIVITY
L. E. Lipetz, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 144/155, 40 refs.

The concept that the activity of neurons is both passively and actively modified by the surrounding glial and other non-neuronal cells is found in this review to be supported, but not conclusively demonstrated, by recent and previously unreported experiments. The evidence makes such non-neuronal control seem highly likely in the vertebrate retina.

APPLICATION OF NEURAL LOGIC TO SPEECH ANALYSIS AND RECOGNITION
T. B. Martin, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 189/196.

This paper describes signal-processing techniques for the recognition of speech phonemes by machine. An attempt has been made to employ, wherever useful, basic processing functions of the human auditory system. . . .

SELECTED ANNOTATED BIBLIOGRAPHY ON SYSTEMS OF THEORETICAL DEVICES
C. R. Montgomery, Parke Mathematical Labs., Carlisle, Mass., Scientific Report No. 4, AFCRL-63-515; AD 425 691, Sept. 1963, 51 p., refs., N64-13622.

. . . (1) automata and self-duplicating machines; (2) logic, including computing and abstraction; (3) neurosphysiological systems, including bionics and simulation; and (4) switching, including electrical systems . . .

PRINCIPLES OF ACCOMPLISHING LEARNING AND LOGICAL PROCESSES IN AUTOMATIC EQUIPMENT
P. Neidhardt, Joint Publications Research Service, Washington, D.C., 10 May 1963, 20 p., AD 408 824.

. . . principles of adaptive automated technical systems. These are self-organizing, dynamic systems, capable of learning, which represent the last, still inadequately studied group of cybernetics, which up to now has dealt chiefly with self-regulating and self-stabilizing systems . . .

A PHOTIC STIMULATOR
O. Pawloff, et al., Proc. Instn. Radio Engrs. Australia, vol. 24, no. 1, Jan. 1963, p. 53/56.

. . . for medical and psychological research. . . . critical flicker fusion threshold (C. F. F.). . . . The Photic Stimulator (Phot. St.) described here was constructed for the purpose of measuring C. F. F. accurately . . .

RELATIONAL BIOLOGY AND BIONICS
R. Rosen, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 160/162.

"Relational Biology" is the name given by N. Rashevsky to an approach to biological systems in which, roughly speaking, one seeks to understand the properties of these systems in terms of a decomposition into functional components, rather than into structural components as is commonly done in (metric) biology. An approach of this type seems a most natural way of comprehending the types of organization manifested by biological systems. . . . opens the possibility for the realization of systems of biological significance at the engineering level, rather than exclusively at the molecular or biochemical level . . . techniques for the simulation of important biological processes in engineering applications. . . .

ON FUNDAMENTAL LIMITATIONS OF CHEMICAL AND BIONIC INFORMATION STORAGE SYSTEMS
J. Rothstein, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 205/208.

Bionic information storage combines stability and ultramicrominiaturization with self-replication. Rough estimates are given of thermodynamic limitations on stability and bit storage density and observations made on additional constraints self-replicative ability might entail. . . .

SIGNALS ASSIMILABLE BY LIVING ORGANISMS AND BY MACHINES
O. H. Schmitt, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 90/93.

Man-machine systems may be highly unified and tightly coupled so that they operate practically as a single entity or they may be loosely coupled so that the interfaces are easily discernible and the interaction easily understood whether the interface be close to the biological organism, as in the case of bio-transducers or close to the machine as in conventional digital computers. . . . It appears possible to develop communication codes based on mathematical models more closely in conformity with indwelling biological codes and thus to facilitate man-machine and other bio-engineering interactions . . .

NEURISTOR PROPAGATION ON A TUNNEL DIODE LOADED TRANSMISSION LINE (Correspondence)
A. C. Scott, Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 240/241.

LEARNING MATRICES AND THEIR APPLICATIONS
K. Steinbuch, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 846/862, 34 refs.

PERCEPTION AND INTERPRETATION OF DYNAMIC TACTILE STIMULATION
W. H. Stevenson, III, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1127/1136.

This paper describes a system of tactile communications and its associated electro-mechanical devices. Experiments conducted in human engineering indicate that dynamic excitation of cutaneous tissues on a six point limen on the skin can be meaningfully interpreted at rates up to 1000 characters per minute. The Ste-Re System provides an easily learned, coded and decoded language of communications capable of actuating, programming and transmitting information. . . .

LIMITS TO ANIMAL DISCRIMINATION AND RECOGNITION IN A NOISE EXTERNAL ENVIRONMENT
J. L. Stewart, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 116/131.

SYNTHESIS OF LOGICAL SYSTEMS OF GIVEN ACTIVITY
A. Svoboda, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 904/910.

BOOLEAN MATRICES AND THE STABILITY OF NEURAL NETS
R. H. Urbano, IEEE Trans. Electronic Comp., vol. EC-12, no. 2, April 1963, p. 61/66.

OB ODNOM KLASSE PERSEPTRONOV (On a Class of Perceptrons) (In Russian)
V. N. Vapnik, et al., Avtomatika i Telemekhanika, vol. 25, no. 1, 1964, p. 112/120, 5 refs., A64-15238.

. . . differing from the existing ones in the method of learning . . . A comparison is made between the algorithms of various classes of perceptrons and the theory of pattern recognition using a generalized portrait.

INFORMATION PROCESSING BY HONEY BEES
A. M. Wenner, et al., California U., Santa Barbara, 1963, 11 p., AD 416 087.

Complex sounds produced by honey bees have been recorded and associated with a communication act. A foraging bee navigating to a food source must obtain information prior to the flight through this communication act. The sonic signals may be analyzed in terms of fundamental and harmonic frequencies from a single source, or in terms of two separate sources as suggested by the symmetrical configuration of the most probably sound source, the thoracic spiracles. Thus dual sound source may be unique among animals.

A DISCRETE MODEL FOR EYE TRACKING MOVEMENTS
L. R. Young, et al., IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3 April/July 1963, p. 113/115.

A sampled data model was developed to describe the major characteristics of the eye movement control system for nonpredictive tracking. It agrees with experimental transient responses and frequency characteristics for normal eye movements during following of a moving target in a horizontal plane. . . .

NEURISTOR — A NOVEL DEVICE AND SYSTEM CONCEPT (Correspondence)
R. M. Zilberstein, Proc. IEEE, vol. 51, no. 6, June 1963, p. 965.

LOCALIZATION OF SOUND. PART 3. A NEW THEORY OF HUMAN AUDITION
United Research Inc., Cambridge, Mass., Dec. 1963, 34 p., AD 431 310.

. . . shown to depend on a transformation of incident sounds by the pinnae, or external ear. The ears function as a computer-steerable array similar to an electronically swept radar antenna. The form of transformation is that of time delays. Auto-correlation of the time delays by mental function provides localization. . . .

STUDY OF CREATURE COMMUNICATIONS
Armour Research Foundation, Chicago, Ill., Rept. for 1 June 1962 - 1 May 1963, ASD TR 61 620, P2, June 1963, 118 p., AD 407 950.

. . . development of new communication components, techniques and systems from the analysis and/or use of biological pehenomena . . . A system for the efficient encoding of multi-shade pictures is described. The system used a modified version of the contrast detecting sensor cell to transform a gray scale photograph of a two level (black-white) form without loss of pertinent pictorial detail in most cases . . .

BIBLIOGRAPHY OF RESEARCH REPORTS AND PUBLICATIONS ISSUED BY THE BIO-DYNAMICS AND BIONICS DIVISION
6570th Aerospace Medical Research Labs., Aerospace Medical Div., Wright Patterson Air Force Base, Ohio, June 1963, 50 p., AD 418 282.

Related Publications:

A SURVEY OF REGULAR EXPRESSIONS AND THEIR APPLICATIONS
J.A. Brzozowski, IRE Trans. Electronic Comp., vol. EC-11, no. 3, June 1962, p. 324/335.

. . . an exposition of the theory of regular expressions and its applications to sequential circuits. . . .

PRINT RECOGNITION APPARATUS FOR BLIND READERS
J.H. Davis, J. Brit. Instn. Radio Engrs., vol. 24, no. 2, Aug. 1962, p. 103/110, 13 refs.

. . . The facilities offered both to designer and reader by the auditory and tactile types of reading machine are compared. . . . actual machines . . . problems of recognition of the electrical signal and storage and accessibility of the sound tracks in the auditory machine are discussed. . . .

ENGINEERING CYBERNETICS. ADAPTIVE AUTOMATIC CONTROL SYSTEMS (In Russian) (Second Edition)
A.G. Ivakhenko, Kiev, Gostekhizdat UkSSR, 1962, 422 p.

THE REALITY OF BIO-MEDICAL ENGINEERING
J.D. Horgan, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 471/474.

. . . diverse range of activities that it may appear almost futile to define it . . . all the activities involve engineering; all the activities are interdisciplinary. Thus, the educational program should provide a sound background in engineering, all include early and frequent opportunities for involvement in interdisciplinary research.

AN OPTICAL DECISION FILTER
R.D. Joseph, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1098/1118.

SUBJECT INDEX

The terms in the following index were taken directly from the subject contents of the individual subdivisions in the volume. The terms listed under "Included," as well as selected section and subdivision titles, were considered for inclusion in the index.

Multi-noun terms are presented in two ways: 1) the full term is listed in alphabetical order of the first noun, e.g., "aliasing error"; and 2) the full expressions are permuted or separated so as to provide multiple listings of a single expression, e.g., "error, aliasing". General usage of the technical terms is followed in the permuting process; combinations of words which fail to make technical sense are not included.

In instances where a particular term is not located in the index, the user should refer to the table of contents. When used in conjunction, the table of contents and index will enable the user to locate the proper section or subdivision and, in turn, the pertinent citations.

As a general rule, if a proper name, e.g., Fourier, identifies a theory, process, etc., the name has been included in the index. Words and expressions that denote general concepts, e.g., systems, problems, technologies and techniques, methods, etc., have not been included in the index.

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